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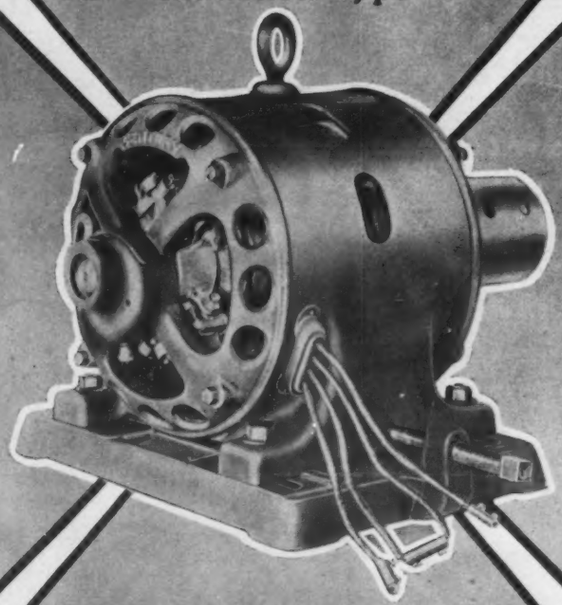

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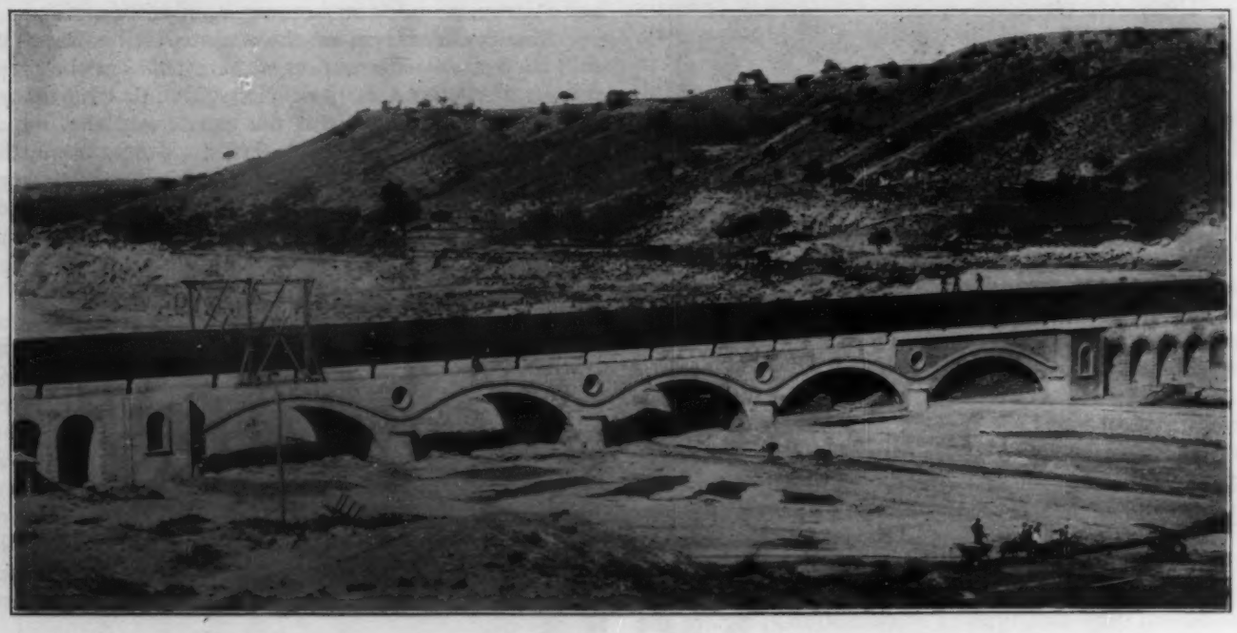
ELECTRIC PUMPING AND IRRIGATION

BY B. A. ETCHEVERRY.[1]

General Character and Parts of a Gravity Irrigation System.

Water for a gravity irrigation system is ordinarily obtained by building a dam or diversion weir across a stream, thus checking the water and forcing it to flow into the head of a canal. By making the grade of the canal less than that of the stream sufficient elevation is gained to reach the higher points of the land to be irrigated some distance from the stream. This portion of the canal is called the diversion line.

The character and the cost of the diversion line construction is determined by the topography. If the diversion site is high up on the river where it runs through rough hills or deep canyons the construction will be correspondingly difficult and expensive. Where a hillside is too steep for open canal excavation, a flume must either be supported on a bench cut in the hillside or a concrete rectangular section must be made with a retaining wall on the down-hill side. Where depressions must be crossed with flumes or siphons or where ridges are tunnelled, especially with a long diversion line, the cost is considerable. Where the diversion dam can be constructed lower down the stream where it emerges into the valley the installation is simpler and the diversion line shorter, thus materially reducing the cost.



Sosa Bridge, Spain.
(This is a three-hundred thousand dollar siphon structure completed abroad in 1905 and illustrates obstacles to be overcome in crossing dry washes.)

From the highest point of the area to be served the main canal is continued so as to skirt the land. The main branches or laterals head at the main canal, and, when possible, run down the ridges that separate the smaller valleys constituting the system. These laterals either supply the farms directly or feed sub-laterals.

Drainage channels are provided to receive all excess or waste water from the main canal and laterals

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so as to prevent the land from being waterlogged or to avoid the accumulation of alkali. These drains may be either natural, occupying the previous drainage lines of the sub-basins and deepened or straightened where necessary, or artificial.

It is thus seen that the parts of an irrigation system may be classified into five main groups with their corresponding subdivisions as follows:

The land and crops.

The source of water supply.

The diversion canal and appurtenances.

Diversion weir with scouring sluices, fish-ladder, log-way.
Canal headworks, with regulator and spillway.
Waterways or escapes to control excess flow in the canal.
Sand gates or boxes to remove sand or silt.
Falls and chutes to regulate canal grades and velocities.
Flumes, inverted siphons and culverts to cross depressions or drainage channels.
Bridges and culverts to cross roadways.

The distribution system and pertaining structures.

Check gates in the main canal to control or raise the water and force it into one or more branches or through an escape.
Headgates or turnout gates at the head of laterals to control the flow into them.
Division boxes at the head or junction of small laterals or farm ditches.
Wasteways, escapes or spillways located at drainage channels.
Drops or rapids.
Drainage crossings: flumes, siphons, culverts, level crossings.
Road crossings, culverts, bridges.
Measuring boxes or devices at point of delivery to private ditches.

The drainage system.

The character of irrigation systems vary greatly with the topography and water supply of the country. Where the irrigable area is a large body of land in a broad flat valley, and the water supply is plentiful, the system will consist of earth canals on a flat grade with few interesting structures. These will consist largely of checkgates, headgates and division boxes to control the flow into the different branches and of bridges or culverts at the roadway crossings.

Where the area is rough and steep, many difficulties are encountered on the diversion line requiring practically all the types of structures enumerated above and the planning of the distributing system requires careful consideration.

Where water is valuable and the topography rough, concrete lined canals and pipe distribution systems have many advantages and while this form of construction was until recently limited to southern California, there have been during the past few years some interesting systems of this type constructed in Oregon, Washington, Idaho and British Columbia.

The cost of construction also varies greatly with the topography and type of construction. Where the diversion line is short and where the area to be irrigated is large and the surface smooth and fairly level, but with sufficient grade to give suitable velocities in the canals, it will range between $15 and $25 an acre. Where the area to be irrigated is more or less rolling and the diversion line fairly long, $25 to $40 an acre should cover the cost of construction. Where the diversion line is long and along rough and rocky hillsides and the area to be irrigated steep and rolling, requiring considerable fluming or pipes, the cost of construction will range from about $40 per acre to $60 or even $80 per acre. The lower price in each case is for favorable conditions and less permanent construction.

Before undertaking an irrigation project, the promoters must know its general feasibility, as determined by preliminary investigations. The cost of these investigations must usually be kept down to a minimum and this often precludes the making of a detailed examination and surveys. The engineer can frequently obtain the necessary information by consulting the reports, bulletins, and maps of the different bureaus of the U. S. Department of Agriculture, Department of the Interior, or any other information compiled by the state or private sources.

A general field examination of the project is often warranted and in some cases the importance of the project and the lack of available information may justify extensive hydrographic and topographic surveys. Usually the investigations will cover the land, the crops which may be raised, the water supply, the ownership of the land, and the cost per acre of construction of the system. These factors are related and must be considered together.

The Land and Crops.

The determination of extent of irrigable area includes an estimate of the land area to be covered by the system and of the proportion of the land to be actually irrigated to the total area under the system. For this work the engineer may in some cases be assisted by the topographic maps of the U. S. Geological Survey, or by state, county and private maps.

The configuration of the country will affect not only the cost of construction of the canals but the preparation of the land for irrigation. Rough land makes the cost of construction of the canals and the preparation of the land high. A flat slope may limit the velocities in the canal, making large canals necessary; it also makes it difficult to install measuring devices and to deliver water to the farms at sufficient elevation. The best land is that which is smooth and has a fairly good slope.

The character of soil and vegetation is determined by borings with a soil auger, by means of which soil samples are taken for analysis and the depth and physical condition of the soil observed. The presence of hardpan close to the surface is a serious detriment. Where soil surveys have been made by the U. S. Bureau of Soils, the borings may not be necessary. The character of the vegetation is an indication of the character of the soil; sagebrush, cactus and buffalo grass grow on good deep soils; salt grass and other alkali weeds grow on land which may contain considerable alkali.

An impervious clay soil or a tight silt soil through which the water will percolate slowly, or a soil which will puddle, bake or crack after irrigation, is hard to irrigate and cultivate. A soil which is too porous will make it difficult to irrigate without loss due to deep percolation.

The presence of alkali in the soil and the lack of natural drainage must be carefully looked into. The practice of irrigation will usually aggravate the alkali conditions, especially at the depressions where seepage water from irrigation canals or from wasteful irrigation on higher lands leaches out the salts from the higher lands, water-logging the land and concentrating the salts at these depressions. While the natural sur-

face drainage may seem adequate, the surface soil may be underlaid with hardpan or impermeable strata or dikes which interrupt the subflow and not only interfere with drainage along the natural drainage lines but also produce water-logging and rise of alkali at the foothills, although the open texture of the soil may seem favorable to good natural drainage. Borings or test pits are necessary to determine the character of the subsoil. There are few irrigation systems where drainage is not necessary and the construction of an irrigation system generally includes a drainage system.

Headworks of Yakima Sunnyside Project, Washington.

The character of crops depends on the soil, elevation and all climatic conditions. Valuable information may sometimes be obtained from observations of crops grown in surrounding regions under similar conditions.

The demand may be local, but usually for an extensive area there must be a general demand. The possibilities for development of various industries such as creameries, sugar factories, mills, fruit packing houses, canneries, must be investigated.

The cost of producing comprises: (1) interest chargeable to the cost of the land including the cost of irrigation works, preparation of land and all improvements, (2) cost of maintenance and operation for

Concrete Retaining Wall on Modesto and Turlock Canals.

irrigation water delivered, and (3) labor cost of applying water and cultivation, harvesting, etc.

The cost of marketing will depend on the distance from market; on the means of communication, either railroad or navigation; and on the character of product to be marketed. For instance alfalfa may be used for dairy purposes; sugar beets may be marketed in their natural state or manufactured into sugar prior to marketing.

On the value of crop will depend largely the feasibility of the project. A project which might be prohibitive in cost for raising grain or alfalfa may be quite feasible for orchards.

The ownership of the land is either public, or private, belonging either to the canal builders or private owners. In the case of public lands, unless the lands and system be developed under the Carey Act, the result is usually disastrous to irrigation companies. The land is largely taken up by speculators who hold down their claim without using the water or purchasing a water right, waiting until they can dispose of their holdings to a real settler at a high profit, thus deriving all the benefits of the system. This results in slow development, the company receiving little revenue, while the interest on their capital and the depreciation of the system means ruin to the investors. The same conditions, but a less extent, are liable to prevail where the lands belong to private individuals unless they will sign contracts for the purchase of water

Concrete Lined Tunnel, Truckee-Carson Project.

rights and agree to pay the annual charge of operation. In this connection it is well to investigate the present character of the use of these lands and whether irrigation is necessary or simply desirable. The possibility of changing to a system of agriculture requiring water must be looked into and whether this can best be done by converting those already on the land or by immigration colonies. Generally an irrigation company can not be financially successful unless the land and the irrigation system are under the same control, for the profits come from the increased value of the land and not from the annual sale of water.

The cost of the system cannot be closely estimated without the surveys, examination of the ground and design of the structures, but an approximate estimate can be made by a general examination of the character of the land to be irrigated and of the general topography along the probable location of the diversion line, assisted in some cases by preliminary survey lines or hasty reconnaissance survey. As a rule the estimates of cost are too low. The actual cost of construction is only one item of cost. The other items, for which due allowance is not always made, are:

1st. Preliminary surveys, designs and estimates which may be estimated at 5 per cent of construction cost.

2d. The expense of organization and promotion with the reimbursement of original promoters, estimated at 10 per cent of construction cost.

3d. General adminstrative expense during construction period, estimated at 10 per cent of construction cost.

4th. Interest charges on bonds during the construction period (2 to 5 years) and the settlement period (2 years) will amount to 20 to 30 per cent of construction cost.

The total of these items shows that the bond issue must exceed the actual engineering cost of construction by at least from 45 to 55 per cent, depending on the period of construction and settlement.

The sale price of the land should include the total cost of construction and development, the purchase price of the land, the commission for the sale of lands which may amount to 10 or 20 per cent of the sale price of the land if disposed of in small tracts and the profit which should be commensurate with the risk involved.

Miscellaneous Considerations include rural advantages such as the existence or establishment of churches, schools, roads, etc., and the available fuel such as gas, electricity, wood, oil, coal, especially important where pumping is necessary.

Water Supply.

A study of all rainfall data, the extent of precipitation, its monthly distribution and its relation to the needs of crops is important. This information can usually be obtained from the Weather Bureau of the U. S. Department of Agriculture. A large mean annual rainfall is no indication that irrigation is not necessary or desirable. The value of irrigation in regions where the annual rainfall is large is well demonstrated by the extension of irrigation in the Rogue River Valley and the Willamette Valley of western Oregon and in parts of the Sacramento Valley where a few years ago it was thought that irrigation was not desirable. In the Willamette Valley the mean annual rainfall is about 44 inches but the rainfall during the spring months of April, May and June is about 7.05 inches and during the summer months of July, August and September only 2.81 inches. Experiments made in this valley by the U. S. Department of Agriculture show that in general the intelligent application of water to crops such as potatoes, clover, alfalfa, corn, beans, onions, etc., will easily increase yields from 75 to 150 per cent. In the Rogue River Valley the total annual rainfall is about 26.57 inches, the rainfall during the spring months is 4.22 inches and during the summer months, 1.45 inches. In this valley the orchards that are producing the heaviest and yielding the largest profits are irrigated.

Study of stream flow is best obtained from gaugings extending over a number of years, especially those including periods of drought. On some streams this work has been done by the U. S. Geological Survey and the information may be obtained in the Water Supply Papers. In some states, the state engineer has done considerable work on stream gaugings, the results of which are given in his annual reports. These are the two main sources of information. At times it is possible to obtain information from private sources. If no information is obtainable it is best to establish at once a gauging station and make observations for as long a period as is possible. If the time will not permit the gauging of the stream for any considerable period an estimate of the run off may be obtained by a study of the watershed and the precipitation on it. A study of the watershed as affecting run off will include:

Area of watershed.

Character of surface—rough or smooth, steep or level.

Bare or wooded.

Elevation of watershed. An increase in elevation increases the precipitation and will retain the snow or ice later in the year, helping to maintain the summer flow.

Character of soil and subsoil with its geological formation.

Climatic conditions: temperature, wind, etc.

Probable changes in character of supply due to settlement and use of water in upper valleys.

A study of the precipitation will include:

Distribution of precipitation.

Character and extent of precipitation—whether in the form of rain or snow and whether sudden storms or gradual falls.

The U. S. Weather Bureau is the main source of information concerning precipitation. With the precipitation and the area of the watershed, the runoff is estimated by assuming a coefficient of runoff. This estimate is necessarily rough but one may obtain a fairly close approximation by determining the coefficient of runoff from stream gaugings which it has been possible to obtain for a limited period. If stream flow data from similar adjacent watersheds may be obtained, a fairly accurate estimate of stream flow may be obtained by comparison of watersheds and precipitation.

The amount and variation of the stream flow will show the relation between maximum period of flow and maximum demand of water for irrigation. An analysis of the water, especially during low water period, is necessary if there is any doubt as to its quality.

Volumes appropriated and used, and earlier rights include the volumes recorded, appropriated, and used; the volume recorded or filed on but not used; and the riparian rights in those states which recognize them. In those states where modern water codes are operative and where riparian rights are not recognized, the methods of obtaining and defining rights are provided for; and accurate information can frequently be obtained from the state engineer. In the states which have not modern codes and where riparian rights are recognized, it is difficult and often impossible to learn with any degree of certainty the extent of prior rights. An inspection of recorded rights is of little value, for without a field examination the value of the records cannot be determined. A field survey of volumes actually used and of probable future extensions is necessary. Not only the extent of the uses must be known but also the character of the uses. There are: (1) uses which may not diminish the volume, such as power and mining in some cases; (2) the uses which diminish the volume, such as domestic and stock use and irrigation of areas having prior rights or riparian rights; (3) uses which increase the flow, such as return waters from areas irrigated above or water stored for power purposes; (4) uses which affect the quality of water, such as some forms of manufacturing and mining.

The location of proposed diversion with reference

to other uses must be considered. This includes (1) the possibility of interfering with riparian or prior rights below, or the interference by increased use by riparian rights above; (2) the necessary regulation in case of stored water and the exchange of stored water where water is stored below point of diversion. The seasons of the diversions, whether continuous or intermittent, must also be considered.

Volumes unappropriated may be obtained from the stream flow data and the rights of prior appropriators and riparian owners. A study of the relation of this to the water supply needed for the irrigation system is the next consideration.

Water supply needed for the irrigation system requires a determination of the amount needed and the season of need. When the demand is greater than the available supply during part of the irrigation season, but is less at other times, the deficiency may be supplied in three ways: (1) by storage in artificial reservoirs, which will require the examination of reservoir sites and a study of available flood flow; (2) by encouraging the growth of crops which will create a demand for irrigation water at the time when the supply is most plentiful; (3) by storing water in the soil by winter irrigation or irrigation during period of maximum flow. This requires a soil which will retain the moisture and have it available for the crops during the growing season. Orchards and deep rooted crops are best adapted to this practice. This same process may be applied to the replenishing of underground waters where pumping is extensive by spreading the flood waters over the porous fan-shaped deposits formed where the stream emerges from the hills into the valleys. In southern California this is done by spreading the flood flow by means of flood ditches placed on a flat grade across the longitudinal slope of the valley. The water supply needed will be based on the duty of water.

The gross duty of water determines the capacity of the main canal and the necessary stream flow. It represents the relation between the quantity of water entering the main canal and the total area of land irrigated. It includes, besides the quantity applied to the land, all losses and waste in conveyance. The duty of water obtained on the laterals eliminates the losses occurring between the head of the main canal and the head of the laterals, and is therefore higher than the gross duty.

The net duty represents the water delivered to the field. It must be distinguished from the correct amount of water required for maximum production for it merely represents the volume of water which is used, depending on the abundance of supply and the judgment and skill of the irrigator. The correct amount of water to use is that quantity which is necessary to produce maximum yield when all the losses by percolation, evaporation and waste which can be controlled by ordinary careful methods of irrigation and cultivation have been eliminated. The net duty of water is affected by the following factors: (1) kind of crops; (2) preparation of land, method of application of water and skill of irrigator; (3) time and frequency of cultivation; (4) number of seasons irrigation is practiced because of rise in water table; (5) climatic conditions, rainfall, temperature, humidity in the air, wind movement; (6) character of soil and subsoil; (7) value of water, method of payment for water (whether for quantity used or flat charge per acre), and judgment of irrigator. This factor of cost combined with the judgment or lack of judgment may have more effect on the duty of water than all the other factors together.

The gross duty of water will depend on the net duty and on the transportation losses. The duty is generally lower for a new system because seepage losses are greater with new canals, new lands require more water, water is more plentiful as only part of the land is irrigated, and the irrigator is less skilful. As the system becomes older less water is used and the gross duty increases. This is well shown in the following table.

Gross duty of Water Under Sunnyside Canal, Washington.

Year.	Area Irrigated (acres).	Quantity of Water per acre. (acre feet).
1898	6,883	11.4
1899	8,497	10.6
1900	10,947	10.2
1901	14,964	9.6
1902	18,870	9.1
1904	32,000	6.0
1909	47,000	4.57

This table shows that after eleven years only 2-5 as much water was used as in the first year. The relation between the net duty and gross duty is illustrated by the following examples:

State.	Canal.	Gross duty, or water diverted by canal. Acre feet per acre.	Net duty, water delivered to farms. Acre feet per acre.	Per cent.	Remarks.
California ..	Gage	2.16	1.98	92	Concrete lined canals & pipe systems.
Idaho	Ridenbaugh laterals	4.79	2.50	52	
Washington.	Sunnyside	9.60	3.96	41	For year 1901
Washington.	Sunnyside	4.57	2.79	68	For year 1909

These measurements show that for the Gage Canal system, which consists of a main canal, concrete lined with cement mortar about 1 in. thick, and pipe distributaries, 92 per cent of the water diverted reaches the land. The measurements for the Sunnyside canal show the increase in efficiency of a system as it gets older. The above results indicate that in a new system of unlined earth canals, the water delivered to the farms is probably not more than 40 per cent of that diverted. For old canals in good condition the efficiency will be increased to 65 or 70 per cent.

Water supply from underground sources must be investigated where surface water is deficient or absent. The forms of occurence are usually (1) in the surface zone above the first impervious stream; (2) between two impervious strata in which case it may be under pressure and in some cases artesian; (3) below the bed of streams or natural drainage lines as an underflow. The means of development are (1) wells, either deep or shallow with pumping plants; (2) artesian wells; (3) underground collecting galleries or submerged dams to divert the underflow. The geological conditions favoring the occurrence of underground waters must be investigated. The underflow of streams can be estimated fairly closely by measurement of the cross section of the underflow channel and the velocity of flow. Where existing wells are found in the vicinity they will be helpful indicators of what may be expected.

RATE FIXING AND APPRAISAL

REASONABLE GAS RATES AND THEIR DETERMINATION.[1]

BY C. L. CORY

There is no more fundamental proposition than that the rates charged by a public utility company must not be greater than the service is worth to the customer, and must not be less than sufficient to yield a fair or reasonable return to such public utility company.

It is evident that any standard based on what a service is worth to a customer is in most cases vague and indefinite. The rates paid for the same commodity in other communities is often used, many times to the exclusion of all other factors, as a dependable and equitable guide to be followed in any given case.

Again it is often maintained that in every instance such rates must depend primarily upon the cost to the public utility company of supplying the commodity to every customer desiring such service.

Neither of these two principles can be said to be always applicable or infallible.

Thus it is that many factors are involved in the determination of the proper rates for gas service. Viewed both from the standpoint of the consumers and the companies manufacturing and supplying gas, the careful consideration of many complex, and in some cases, conflicting elements is absolutely essential for real ultimate economy and mutual advantage to both sides.

It is the object of this paper to briefly and, in a general way, discuss some of the more important details involved, to the end primarily that the discussion may indicate the way toward the adoption of, and possibly definitely establish, some principles of ultimate value to the gas industry.

Quality of Service.

While the rates to be charged consumers are of the greatest importance, the quality of the service is of more vital consequence. The supplying of gas in an urban community is more easily accomplished in some respects than the furnishing of electrical energy for light and power. Although the use of gas, like electricity, is confined largely to certain periods of the day, resulting in what are known as peak loads, and also hours of practically no consumption whatever, yet the successful storage of gas in large holders, to be drawn upon as required, eliminates, to a considerable extent, the necessity of providing a manufacturing plant proportional to the magnitude of the maximum demand, as must be done in most electrical generating stations.

As a result of the adoption of convenient and economical methods of storing gas, the manufacturing plant need be no larger than the average use throughout a twenty-four-hour day which is a manifest advantage. On the contrary, however, the distributing systems, from the gas holders to the many consumers' meters, including the trunk mains, secondary mains, laterals, and services, must be installed of such size as to provide an adequate pressure and quantity of gas to the most remote consumers, especially during the hours of maximum demand. There is a direct similarity then in this regard in the distribution systems for both gas and electric service.

Gas distribution systems in general, however, cost more per consumer, or perhaps, to put it in a better way, more per dollar per month paid by consumers, than electrical distribution systems, especially in comparison with overhead pole line construction in electrical distribution. The gas distribution systems are of a more permanent character, and should be less often changed or enlarged. The ultimate result is usually then that investments are made in gas distribution systems in advance or ahead of the immediate probable use of such systems, so that the reconstruction, enlargement and reinforcing of mains, necessitating the tearing up of pavements and continual excavation of streets, are the less often required.

But no matter how old or limited in capacity a gas distribution system may be, it is of vital importance that all customers may be adequately served with gas at the proper pressure when the demand is greatest and to meet this requirement, it in some cases may be desirable to install an automatic pressure regulator for each individual customer. While the cost of such regulators is considerable, approximately four or five dollars each, installed, the improvement in the service is very marked and inevitably results in a material reduction in expenditures for trouble men as well as other costs of correcting the troubles of customers caused by a considerable variation of pressure at the gas consuming devices.

Uniform chemical composition and thermal value in the gas supplied are also essentials of good service. Impurities, especially sulphur, are very disadvantageous to customers and often result in the very rapid deterioration and expensive replacement of gas consuming devices and auxiliaries.

Further consideration of what is proper service will not be attempted, except to emphasize most forcibly that good service is absolutely necessary. Anything less than the best reasonable service is a most serious matter to be corrected by the co-operation of the rate regulating body if any, the consumers, and the gas company at the earliest possible moment. Continued poor, inadequate, or unsatisfactory service to even a relatively small number of customers is intolerable and cannot but ultimately result disastrously to the company as well as its customers.

Almost any user of gas can, and probably under the pressure of threats to cut off the gas (and no possible chance to get the desired service from another company), will pay even exorbitantly large or unreasonable gas bills, but even with a flat rate of a few cents per month, poor service with impure gas of insufficient pressure when most needed, probably for cooking breakfast or dinner, and no possible relief from

[1]Paper read before the Pacific Coast Gas Association, September 18, 1912, San Diego, Cal.

a competing company, is an abomination, and is not only wrong in principle, but is directly contrary to true constructure ideals, is in direct violation of the eleventh commandment of Holy Writ and may be urged in the future life of the unhappy and tormented spirit of the abused gas user as a reason for his or her condemnation to eternal punishment; and I leave to your imagination the excuses that the responsible officials and owners of gas companies will, with parched throats and pleading and halting voices, utter while they too are struggling vainly to escape from the bottomless pit of Hades, there to be tortured for all future time with the most unheard of, preposterous and unjust complaints of payless customers, constantly reduced rates, and increasing deficits, while submerged to their necks in sticky lampblack and in a sulphurous atmosphere of a temperature and humidity, such that the heat of the fire-brick checker work in the interior of an oil gas generator when operating at full capacity would seem to be the absolute zero, minus 473° C., when compared therewith.

Mutual Responsibility of Gas Manufacturer and User.

The obligation of the gas company, then, to give good, adequate and proper service is established, providing, however, that this obligation is in reality of a mutual character, in which those controlling the rates and service, as well as the customers, accept, and continue, without repeated lapses into political intrigue, to do their honest share in the carrying out of what is, after all, a mutual contract.

In my paper last year reference was made to this important phase of the situation, but it may be well to here briefly mention some other considerations most directly relating to the determination of gas rates.

How can a company, individual, or any kind of an organization, properly and satisfactorily furnish any kind of public utility service, constantly extending their systems and increasing their investments coincident with the rapid increase of population, if no protection is given them from what are really destructive "shoe string" competitors or even competitors of the most powerful but piratical character.

Among the public utility service corporations, the gas company stands among the foremost as a desirable natural monopoly in any given district, and for the reason that is often not appreciated by many people, namely, to protect the public and upbuild the commonwealth.

The absurdity of having duplicate gas distributing systems, belonging to different separately operated companies, may be inferred from what has been said above From what will be shown later in actual figures, the fixed charges, independent of the amount of gas made or sold, represent a much larger portion of the cost of properly serving customers than will be found to exist in the conduct of the business of many other public service companies. The wide variations in gas rates in the different cities on the Pacific Coast show this conclusively. The quantity of gas made and sold from a single manufacturing plant is certainly one of the most important factors in determining gas rates.

It is a fact which cannot possibly be controverted that the cheapest possible gas rates may be perpetually maintained to the ultimate benefit of all parties concerned and with the greatest economy for all time, when the largest number of gas consumers are served from a single operating system, especially for distribution in any geographical district.

And it is also true that the larger the district served from a single manufacturing plant, as long as the average density of population using gas does not become too low, other conditions being the same, the lower may the gas rate be made and maintained continuously to the mutual advantage of both manufacturer and user.

Is it not inevitable that the false economy of dividing the total gas sales in a given district between two or more separate manufacturing and distributing companies is and always will be a burden that will be borne largely by the commonwealth, and tend toward the financial embarrassment of all, including gas companies and their consumers?

It must not be forgotten in connection with the above argument against unrestricted competition that it is assumed an able commission or other regulating body, wisely and with full knowledge based upon careful investigation, has complete control of the regulation of rates and quality of service of the one monopolistic gas company.

The so-called regulation of rates and service directly by inexperienced though well-intentioned municipal or county officials elected by the people, often for no other reason than their political affiliation or delightful, or otherwise, personal qualities, without any real understanding of the facts, is as absurd on the face of it as to entrust to the generous proportional Indian squaw of the Arizona desert the judging of the modishness and beautiful blending of delicate colors of the creations so dear to the civilized feminine heart, on exhibition, to the destruction of the masculine pocket-book, at our spring and fall fashion shows, or to leave to the untutored and lazy Apache, whose epicurean tastes are limited to Indian corn and tulapi, the planning of the banquet for this evening.

No decree or judgment can endure and be constructive rather than destructive in its effects upon humanity unless the judge, in rendering such decision, combines knowledge, experience, wisdom and justice.

HYDROELECTRIC PLANT AT PANAMA CANAL.

Operations have begun for the erection of the permanent hydroelectric station at the Spillway of Gatun Dam. Excavation for the turbine pits, close by the Spillway discharge channel, on the east side, has been carried to 5.25 feet below sea-level, over an area of 100 by 30 feet. The sheet steel penstocks are being assembled on the north toe of the Gatun Dam, near the spillway. The penstocks, of which there will be three, with provision for the installation of three more, if desired, will each be 10 feet 6 inches in diameter, of ⅜-inch steel, banded at intervals of three feet with 3-inch by ⅜-inch Z-bars, all set in concrete. The center of intakes will be at elevation plus 68.25, and their discharges into the turbines at elevation plus 27. When Gatun Lake is at its normal level of 85 feet above sea-level the effective head on the turbines will be 77 feet.

RECENT DEVELOPMENT IN DIESEL ENGINE APPLICATION.

BY J. W. WHITE, Jr.

While but fifteen years have elapsed since the first internal combustion engine operating upon the Diesel principle has been built, its present standing in the world of power, and its rapid commercial development indicate that the struggle for commercial supremacy between the steam power unit and the internal combustion engine is now being waged in earnest and present indications are favorable for the internal combustion engine.

The first Diesel engine was designed in 1893, and it is reported that it was expected to run on pulverized coal. The designer intended in its operation to apply the theory of the Carnot cycle to commercial practice. Actual developments did not bear out his original ideas, but the use of oil instead of powdered coal was found to be practicable, and from these experiments, the Diesel engine of today has been developed, so that at the present time a thermal efficiency of 41 per cent has been attained.

Types.

Commercial practice of the present day has called for the development of the Diesel engine in a number of types. Marine work calls for the cylinders in a vertical plane; while stationary practice, up to the present time has been more in the vertical than in the horizontal plane. Vertical engines so far have been built to operate on the four and two stroke cycle, but have not been commercially developed in the double acting type.

The advantage of the vertical type of engine is the smaller floor space required; while the head room is not a material disadvantage. It has the disadvantages, of more vibration, noisier operation, greater bearing strains, inaccessibility of parts, multiplicity of cylinders, bearings, etc., and its ultimate application will therefore be more particularly in marine work.

The horizontal engine has been built to operate on the four and two stroke cycle. The four cycle engines have been built in the single and twin tandem types, double acting, as well as in the single cylinder types, single acting, but within the writer's knowledge no two cycle engine has been built double acting.

The horizontal engine has the disadvantage of taking up greater floor space; while on the other hand, it gives better foundations, less vibration, quieter operation, and the possibility of a direct gear driven valve motion, which is simpler and quieter than the vertical type. In addition to the above, the piston pressures acting horizontally on the main bearings allow of a more perfect balance in the resultant forces of the moving parts, and this factor is desirable where heavy fly wheels are used.

The horizontal type, double acting, encourages the manufacture of much larger units, and eliminates the multiplicity of bearings which are objectionable in the vertical type.

The commercial development of the horizontal form will be most successful in the tandem type, because such construction permits the extension of the piston rod through the cylinder wall, allowing for its support between cylinders and on the piston extension. One distinct advantage of this construction is that it simplifies and makes commercially possible the cooling of piston and rods, and this of itself in the single acting engine materially restricts the size of the unit, and the horsepower per cylinder.

On account of the high temperatures in the cylinder the single acting engine in the horizontal form is more liable to develop scoring of the cylinder walls and lubrication troubles, while these disadvantages would be absent in the same engine built in the vertical plane.

Stroke Cycle.

There are a number of engines now being placed on the market, built on the two stroke cycle. Its some advantages include a smaller first cost, approximately 80 per cent reduction in weight, less floor space, and absence of exhaust valve. In the two stroke cycle engine, the ports are uncovered by the piston just before the end of the stroke. Its disadvantages are an increased fuel consumption of approximately 18 per cent due to the failure to thoroughly scavenge the cylinder; (2) Increased difficulty in cooling. Because the charge is fired twice as often as in the four stroke engine, there is approximately twice the amount of heat developed within the same area, which increases the necessary amount of cooling water while not permitting a decrease in the thickness of the cylinder walls.

The weight of the average two cycle, single acting engine in sizes from 300 h.p. up run approximately 175 lb. per h.p.; while the horizontal engine four cycle weighs approximately 280 lb. per h.p. The horizontal tandem, four cycle engine, which is built on the double acting type has been reduced in weight to approximately 230 lb. per h.p. In the vertical engines an average weight for the four cycle engine is approximately 150 lb. per h.p. as against 100 lb. per h.p. for the two cycle engine.

Compression.

In the Diesel engine a compression of 500 lb. is maintained with a consequent temperature of approximately 1000 degrees F. It is the endeavor of the designers of Diesel engines to burn the fuel charge at a constant temperature in the cylinder walls, and the probable initial temperature of combustion has been estimated at about 1400 degrees; while the exhaust gases issue at about a temperature of 600 degrees F.

Efficiency.

Average European practice shows a thermal efficiency of about 33 per cent, and as already stated, a maximum economy of about 41 per cent. The average distribution of the B.t.u. value of the fuel in an engine developing 33 per cent efficeincy is approximately as follows:

33 per cent developed power.
7 per cent overcoming mechanical losses.
27 per cent exhaust.
33 per cent jacket cooling.

It will be noted that the mechanical efficiency of Diesel engines is higher than that of any other internal combustion engine, one of the principal reasons being that for the same power output the friction load is smaller due to smaller cylinder diameters and stroke lengths. In addition, these losses are minimized in

the vertical engine, which up to the present time has been used more commercially than the horizontal type.

Horsepower Installed.

At the present time it is estimated by Dr. Diesel that 365 vessels have been equipped with the Diesel type of engine, and that the combined installations total approximately 100,000 h.p. No definite figures have been compiled on the total horsepower installed for stationary service. The largest marine engines built and in service are two engines of 1250 h.p., each operating on the Selandia, owned by the East Asiatic Company; the ship being of 7400 tons displacement. The successful operation of this boat has encouraged its owner to let contracts for two sister ships similarly equipped.

At the present time a boat now under construction is being equipped with two 2100 h.p. Diesel engines for the German American Oil Company, to be used in a 15,000 ton tank steamer. Both of these installations indicate that the limit of size in construction of Diesel engines is being rapidly expanded.

The largest stationary engine of which the writer knows is a 2000 h.p. twin tandem, four cycle, double acting engine, built by the Machinfalrick-Nuremberg, A. G., of 94 r.p.m., direct connected to alternating current generator, and installed in the lighting plant of the City of Halle, Germany, but at this writing there is building on the continent a 4,000 h.p. engine of twin tandem, double acting type.

Cylinder Capacities.

The natural practice in marine work would be toward a smaller ratio of diameter to stroke, and marine practice ranges from 1-1. to 1-1.5 with an average of 1-1.25. The largest cylinder sizes at present in operation are 12 in. in diameter by 20 in. stroke at 140 r.p.m., i.e.: 150 h.p. per cylinder, and operating on the four stroke cycle. Present indications are that cylinders built in units of 250 h.p. each for marine work will be developed shortly. The largest cylinder capacities in the stationary engines at the present time are 500 h.p. per cylinder; same being of the four cycle, double acting type. There are under construction, however, engines having cylinder capacities of 1000 h.p. per cylinder, being four cycle double acting.

Stationary cylinder ratios are greater than in marine practice to give lower rotative speeds, a better cooling. The amount of cooling water increases as the square of the diameter and the cube of the volume. It is therefore evident that a long stroke will give lower first cost, thinner cylinder walls, and less cooling water per unit of power.

Stationary cylinder ratios vary between 1-1.4 to 1-1.5 in both the two and four cycle engines.

American vs. German Practice.

The thermal efficiency reached by American manufacturers is considerably lower than that obtained on the continent, and there are a number of reasons why higher economies are not obtained.

The German mechanic is of higher grade than the American mechanic, and gets paid a much smaller wage. He is domestic, and specializes on one type of work, and it is customary for German mechanics to live and die in the employ of one company, unless pensioned. German foundry practice has been developed to a much higher degree abroad than in the United States, which explains why the German engines are not troubled with cylinder cracking from temperature strains, when this same trouble is the principal one experience with American engines.

American practice places the exhaust ports on the side walls of the cylinder because of the difficulties experienced in casting them in the cylinder head. From the foundryman's point of view in Germany, the casting of the cylinder head now presents no difficulty. Before the best process and mixture were found, the fact was developed that it was not essential to have only the closest and densest blends. It was proved that the best results were obtained with ordinary iron, such as is used for steam engine cylinders. All that is required is to use special care during casting to keep the liquid iron in constant motion until poured. so that the iron may be uniform in texture and homogeneous.

There are several radical differences between the construction of the German and American engines.

In the German engines a screened intake port is used to prevent any foreign matter from entering the cylinder, and this feature, more than any other, probably explains why the German engines are not scored in the cylinder walls, and have so little trouble in lubrication.

In mounting the valves on the engine, it is German practice to place them in the cylinder head. all mechanically operated by levers instead of spring operated valves of the poppet type. Positive actuation of these valves is a marked superiority and prevents leaky ports, due to the fact that the valves are mechanically seated under pressure. On the cylinder head are mounted the exhaust, intake, oil injection, and compressed air ports.

Another marked difference in the construction is that the oil spray is screened for dirt, and is of the multiple port type, making the fuel injection much more perfect than American practice, where it is most often done with a single jet.

In German engines, the air compressor is driven from a bell crank, which cuts out all possible mechanical back lash. Governing is obtained by varying the port opening in the suction of the oil pump; this port being held open by governor action, so that the volumetric displacement of the oil pump varies with the timing of the suction port closing.

In American built engines, the air inlet is usually of the spring poppet type, so that the valves do not open mechanically at a predetermined time, but depend on a minus pressure in the cylinder itself, and therefore, like air compressors equipped with poppet valve intake ports, the volumetric efficiency is much lower than with the mechanically operated valve. A valve of this type necessarily has very weak springs, which give poor seating, and therefore dirt accumulating on the seat of the valve causes leaking at this point. This, together with the fact that the air is not screened at the intake, is one of the most serious defects in the operation of the American built Diesel engine, as it gives poor combustion and smudgy cylinder walls, with leaky valves and dirty cylinders.

Another bad feature in American design is that the valves are crowded together on one side of the cylinder, the intake and exhaust ports being directly above each other, so that the hot gases and the fresh charge of cold air both pass the same point; thus increasing liability of cracked cylinders.

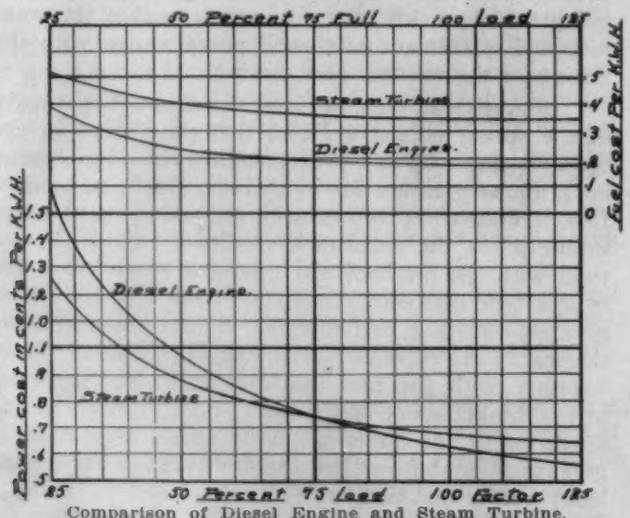
The result is that the average efficiency of American built engines is about 29; while that of the German engines is about 33 to 35 per cent.

Application to California Practice.

On account of the fact that California crude oil runs so high in asphaltum, it is necessary to bring up the compression of the Diesel type of engine to 700 or 800 lb. before oils of 18 gravity can be successfully burned in the cylinder direct. This pressure seems to be beyond good commercial practice, and therefore, engines of this type, with but few exceptions, are not guaranteed to burn oil of lower than 22 gravity, so that in power plants where both steam and Diesel engines could be used, two separate oil supplies are necessary.

In Germany and through continental countries, the price of labor and station attendance is low, interest on money invested from 2 to 3 per cent, there is a scarcity of coal, and the price of fuel oil is high, all of which is favorable to the application of the Diesel engine to central station service particularly. On the Pacific Coast, the price of labor and attendance is high, the price of oil extremely low, interest on money high in comparison, together with the fact that central station service on the Pacific Coast has usually a much smaller load factor than abroad, and therefore, its use in central station service will be confined to carrying the day load, and getting as nearly as possible continuous operation.

Figuring oil at 60 cents per barrel for a steam plant, and 22 gravity oil suitable for Diesel use at 85 cents per barrel, and figuring interest, depreciation, and the setting by of a sinking fund at 15 per cent and making average charges for fuel, station attendance, lubrication, etc., it will be found that the total power cost curve of a Diesel engine operating in a station containing 1000 kw. of this class of prime mover will cross the economy curve of a steam plant of the same size, equipped with two steam turbines at approximately 70 to 75 per cent load factor. These results are shown in curve herewith, where the Diesel engine is given credit for 11.2 kw. hours per gallon of 22 gravity oil, while the steam plant is given credit for 4.2 kw. hours per gallon of crude California oil. Cost of the steam plant is figured at $80 per kw. installed; while the cost of the Diesel is figured at $150 per kw. installed. It is believed that these figures represent average central station practice.



Comparison of Diesel Engine and Steam Turbine.

Few central stations have a load factor above 40 per cent. The majority average between 33 to 37 per cent. A careful examination of most central station plants on the Pacific Coast indicates that about 33 per cent of the peak load would be the largest capacity allowable for Diesel engines operating in conjunction with steam turbines on a central station load; while if it were desired to install a Diesel engine in central station service for continuous operation (i.e.: 100 per cent load factor), the average central station load on Pacific Coast would not allow Diesel capacity in excess of 15 per cent of the total peak.

For marine service on this coast, the Diesel engine should find a fairly good field on account of the fact that in propelling ships a high load factor is obtained, its lighter weight gives the vessel increased tonnage capacity, its greatly reduced fuel consumption and displacement gives the vessel a greater steaming radius, all of which contribute to its saving and earning power to a much greater degree than its relative advantages as applied to saving in central station service.

THE SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.

At the third meeting of the organization committee of the Society for Electrical Development, Inc., at New York, on October 18, the by-laws were approved as a whole, including the article referring to the basis of financing, which is to the effect that the funds to advance the purposes of the society will be subscribed by its members on the following basis: Central station and manufacturing members, not less than one-fifteenth of 1 per cent on the gross amount of their respective sales up to and including $20,000,000, and at the rate of not less than one-twentieth of 1 per cent on the gross amount of such sales in excess of $20,000,000; the contracting, dealing and jobbing members, not less than one-twentieth of 1 per cent on the gross amount of their respective sales.

The board of directors will be composed of five classes (the board having twenty members), four from the central station interests, four from the manufacturing interests, four from the jobbing interests, four from the contracting interests and four at large. These directors will each be elected by the membership represented in the class in which they belong, with the exception of the members at large, who will be elected by the membership as a whole.

Committees were appointed to lay out definite plans for the further financing of the society, and also to lay out plans relative to its policy and the work which it expects to carry out, so that with the election of officers at its next meeting and probable approval of general plans, the society can well be said to be under strong headway after many months of hard work. The meeting will be held on November 18 in New York City.

LEGISLATION VS. REGULATION IN ELECTRICAL DISTRIBUTION.[1]

BY J. E. MACDONALD.

The 1911 session of the California legislature added to the laws of that state over 800 statutes. This is a remarkable record, when one considers the amount of labor involved in drafting and redrafting these measures in committee, before final submission to legislature and senate for acceptance or rejection.

Those of us who are wont to criticise legislative measures should consider carefully the great amount of technical knowledge and sound judgment required to intelligently pass on matters which may be burdensome to a few while at the same time seeking to safeguard the interests of the multitude.

Those associated with public utilities have been very much interested in Chapters 499 and 500 of the 1911 regular session, known as the overhead and underground laws; and Chapter 14 of the extra session, otherwise known as the Public Utilities Act. The former seek, by means of legislative action, the control of all overhead and underground construction, whereas the Public Utilities Act delegates to the Railroad Commission unlimited power over every phase of overhead and underground distribution.

The overhead and underground laws have been in effect since October 22, 1911, whereas the Public Utilities Act has been effective since March 23rd of the present year, and little opportunity has been afforded to observe its bearing on distribution problems. The recent activity of the Railroad Commission, however, as displayed in proposed General Order No. 26, which covers its investigation concerning overhead crossing conditions, furnishes direct evidence that the policy of the Commission is constructive.

It should be noted that the underground law is most reasonable. In two of its most important sections it provides an exception as follows: "Shall not be held to apply where satisfactory proof shall be submitted to the proper authorities, that it is impracticable or physically impossible to comply with this law within the space or location so designated by the proper municipal authorities."

This analysis, therefore, will be confined largely to the overhead law, which has created a great deal of unfavorable criticism. The important provisions of this law may be summarized briefly as follows: (1) provision requiring 13-inch clearance between any wire and center of any pole; (2) provision requiring 4-foot vertical clearance between wires carrying electricity at voltage exceeding 600 and those carrying electricity at voltage less than 600; (3) requirement demanding that crossarms be painted yellow for wires carrying more than 600 volts, or the use of "High Voltage" signs in lieu thereof; (4) provision prescribing manner of placing guys; (5) provision requiring insulation of lateral pipes from overhead to underground; (6) provision prohibiting placing a transformer and arc lamp on the same pole; (7) provision specifying type of construction at high-tension crossings with other lines; (8) provision for installation of safety bolts and clamps for supporting telephone cable; (9) provision regulating manner of placing insulation in railway span wires.

[1]Paper presented before Los Angeles Section, A. I. E. E., October 29, 1912.

Fig. (1) shows the most important of these requirements.

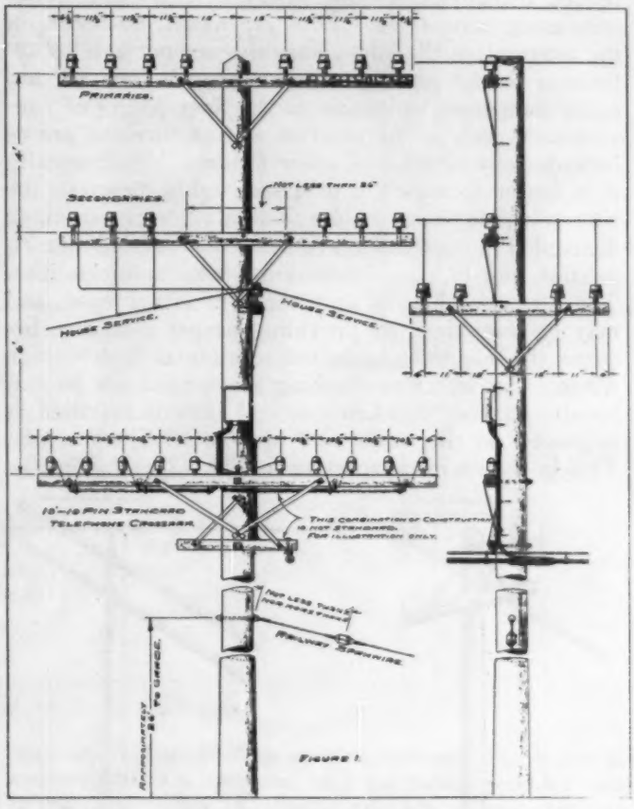


Fig. 1. Illustration of Principal Requirements for Overhead Construction.

Paragraph (a) demands that a clearance of 13 inches be maintained between any wire and center of any pole. This has long been a standard for most telephone companies, exceptions being made in special cases to conform to good engineering principles. Most lighting companies have voluntarily increased this distance to 15 inches, giving a clear climbing space of 30 inches, as compared to 26 inches provided by the law. Exceptions under the provisions governing this 13-inch clearance are as follows:

"Provided, that the foregoing provisions of this paragraph (a) shall be held not to apply to telephone, telegraph or other 'signal' wires or cables which are attached to a pole to which is attached no wire or cable other than telephone, telegraph or other 'signal' wire or cable, except within the corporate limits of any city or town which shall have been incorporated as a municipality, nor shall the foregoing provisions be held to apply to such wires or cables in cases where the same are run from underground and placed vertically on poles, nor to 'bridle' or 'jumper' wires on any pole which are attached to telephone, telegraph or other 'signal' wires on the same pole, nor to any 'aerial' cable, as between such cable and any pole on which it originates or terminates, nor to wires run from 'lead' wires to arc lamps or to transformers placed upon poles, nor to any wire or cable where the same is attached to the top of a pole, as between it and the said pole, nor to any 'aerial' cable containing telephone, telegraph and other 'signal' wires where the same is attached to a pole on which no other wires or cables than wires continuing from said cable are maintained; provided, that electric light or power wires or cables are in no case maintained on the same side of the street or highway on which said 'aerial' cable is placed."

In indicating these exceptions it was, no doubt, intended to provide for the safety of employes of the wire-using companies. They are based, however, on the assumption that the companies are not able to determine proper spacing of wires on pole, and yet are quite competent to decide on the finer points of construction, such as the erection of transformers, arc or incandescent lamps and other fixtures. Mechanically it is better to attach a telephone cable direct to the side of a pole than to place it on a cable crossarm, as demanded in combination construction outside municipalities, and in all construction within municipalities. The electrical hazard is present in either case, and may be minimized by providing proper clearance between the telephone cable and contiguous high voltage wires. The effective climbing space need not be materially lessened if, when a second cable in installed, it is placed on the same side of pole with first cable. This is shown in perspective in Fig. (2). Again, the

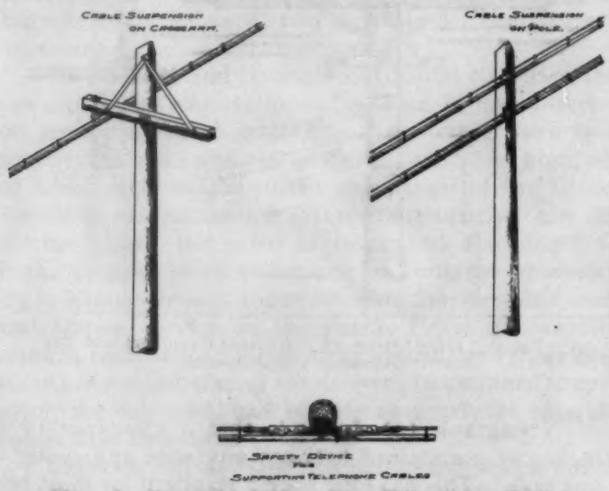


Fig. 2. Recommendation for Telephone Cable Suspension.

13-inch clearance should not be necessary on the toll circuits of the telephone companies. These are never placed in the same location with circuits carrying high voltage if it can be avoided. This involves more than a mere difference of opinion. Certain well-fixed standards, based on correct transposition and spacing of wires, have been established for the production of needed effects. It has not been shown that the electrical hazard has been affected by the maintenance of these standards. The 13-inch clearance is therefore essential as a standard, but some further exemptions from its applications are desirable.

Fig. (3) shows one very good method of mounting one or two transformers on pole and connecting same to line properly, but as far as the "lead" or "jumper" wires are concerned, there is no suggestion as to the correct method of installation, so that they may not be a menace to life and property. The same applies in the exception for "lead" wires to arc lamps. Fig. (4) shows a standard method of suspending an arc lamp, and provided the line wires are erected so as to comply with the law, the "lead" wires may be installed in any manner to suit the constructing company.

Fig. (5) shows a common type of construction in Southern California, being a telephone line and street lighting circuit on a combination pole. This is recognized as being absolutely safe. This method is within the law, but it should be noted that such construction, if not installed properly, would create a dangerous condition.

There is nothing in the law specifying the manner of erecting and maintaining of "bridle" wires, and it would require skillful, logical treatment to express this properly in concrete terms without the aid of a drawing. These are shown correctly in Fig. (1).

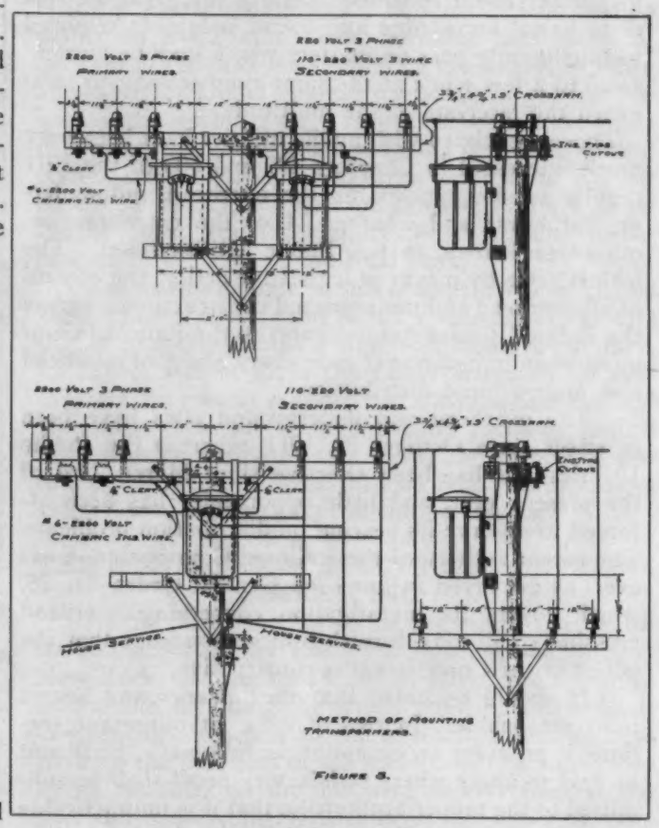


Fig. 3. Excellent Method of Mounting and Connecting Pole Transformers.

Paragraph (b) is similar to paragraph (a), but provides that 13-inch clearance must be maintained from wire to center of pole, as applied to poles and wires erected in an existing lead. This is an excellent provision when coupled with the modifications suggested for paragraph (a). It should be noted that in all cases it is permitted to erect poles and wires for reconstruction on joint poles, and it has been conceded that such poles and wires are not in violation of the law during reconstruction.

Paragraph (c) is the most radical provision of the entire law, and refers principally to the 4-foot clearance demanded between wires carrying over 600 volts and wires carrying less than 600 volts. It is desired to quote this paragraph in full, as follows:

"Run, place, erect or maintain, above ground, within the distance of four (4) feet from any wire or cable conducting or carrying less than six hundred volts of electricity, any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity, or run, place, erect or maintain within the distance of four (4) feet from any wire or cable which shall conduct or carry at any one time more

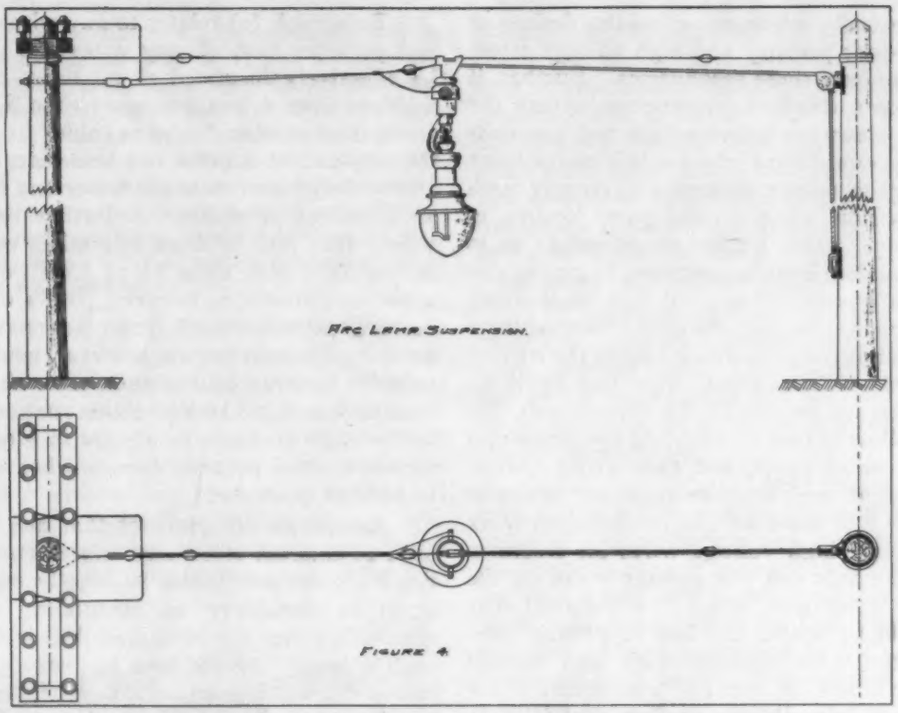


Fig. 4. Standard Method of Arc Lamp Suspension.

than six hundred volts of electricity any wire or cable conducting or carrying less than six hundred volts of electricity; provided, that the foregoing provisions of this paragraph (c) shall be held not to apply to any wires or cables attached to a transformer, within a distance of four (4) feet (measured along the line of said wire or cable) from the point where such wire or cable is attached to such transformer, nor to wires or cables within buildings or other structures, nor to wires or cables where the same are run from underground and placed vertically on poles, nor to any 'lead' wires or cables between the point where the same are made to leave any pole for the purpose of entering any building or other structure, and the point at which they are made to enter such building or structure, and, provided further, that as between any two wires or cables, or any wire or cable run, placed, erected or maintained in violation of the provisions of this paragraph (c), only the wire or cable last in point of time run, placed or erected shall be held to be run, placed, erected or maintained thus in violation of said provision; and further provided, that where no more than one crossarm is maintained on a pole, all the wires or cables conducting or carrying at any one time more than six hundred volts of electricity shall be placed on the crossarm on one side of the pole, and all the wires or cables conducting or carrying less than six hundred volts of electricity shall be placed on the crossarm on the other side of the pole; and further provided, that the space between any wire or cable carrying or conducting at any one time more than six hundred volts of electricity and any wire or cable carrying less than said voltage shall be at least thirty-six (36) inches clear measurement in a horizontal line; and further provided, that where two or more systems for the distribution of electric light or power occupy the same poles with wires or cables, all wires or cables conducting or carrying at any one time more than six hundred volts of electricity shall be placed on the crossarm on one side of the pole, and all wires or cables conducting or carrying less than said voltage shall in such cases be placed on the crossarm on the other side of the pole; and further provided, that the space between any wire or cable conducting or carrying at any one time more than six hundred volts of electricity and any wire or cable conducting or carrying less than said voltage shall be at least thirty-six (36) inches in measurement in a horizontal line; and further provided, that in such construction all crossarms shall be at least thirty-six (36) inches apart in a vertical line."

It will be noted that modifications have been made to provide for joint pole construction; further, it permits the maintenance of wires carrying more than 600 volts on the same crossarm with wires carrying less

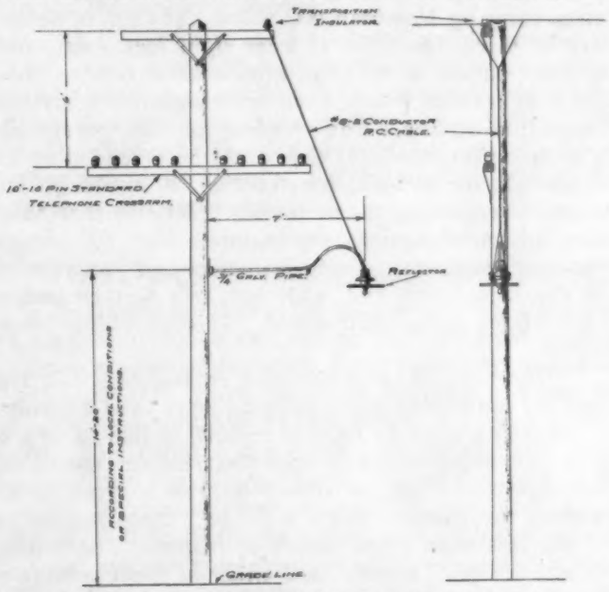


Fig. 5. Series Street Lighting Circuit and Telephone Line on Combination Pole.

than 600 volts, provided high and low voltage wires are maintained at least three feet apart in a horizontal line. In combination construction it is apparently compulsory for companies to maintain all primary wires on one side of a pole and all secondary wires on the other side of the pole. This creates a serious

complication, especially where one company desires to maintain twenty-four primary and high voltage street lighting wires and only three secondaries. Further, if one company adopts standard construction, giving the regulation 4-foot clearance between high and low voltage wires, there is doubt as to whether it is compulsory for the first party to reduce clearance to comply with the 36-inch provision when second party desires to make combination. Some further doubt exists as to what constitutes a distributing company. In giving this paragraph the interpretation implied it is compulsory to modify construction for circuits of the same voltage in a manner which is made to depend upon the ownership of the wires and crossarms. Has this anything to do with the hazard involved? In this respect, the safe course to follow is that of adopting the maximum 4-foot clearance in all cases, and thus avoid contingencies which might arise from an improper interpretation. Again, if it is necessary, in combination work referred to, to place high voltage wires on crossarm on one side of the pole and low voltage wires on the crossarm on the other side, it may be assumed that a company would be within the law in placing telephone lines on the same crossarm with high voltage circuit. Further, there is but one classification for high voltage wires, viz., those carrying electricity at more than 600 volts. This classification admits of great improvement.

With reference to buckarming or leading off from a circuit at crossing or elsewhere, it should be noted that exception has been made for service wires, which may be installed in any manner to suit the operating company, yet, when it is necessary to "buck," it is compulsory to maintain at least four feet between wires carrying more than 600 volts of electricity and wires carrying less than 600 volts. Thus it is necessary to place line arms at least eight feet apart, and in combination work this introduces a serious condition at corners where, even with high poles, serious congestion results. The wording of this paragraph is most unfortunate. If this could be amended so as to provide for rational construction, it would go far toward overcoming the numerous criticisms that have been advanced against the statute. Fig. (6) shows buckarm construction with primaries and secondaries on the same arm, and with but two feet clearance where lines cross each other. This should be permitted.

Paragraph (d) provides that crossarms which are used for supporting wires carrying more than 600 volts of electricity shall be painted yellow, in lieu of which it is permitted to place on crossarms an enameled iron sign, providing, in white letters on a green background, the words, "High Voltage," these letters to be not less than three inches in height. These provisions are quite specific, and either of them provide a questionable measure of safety to employes of the operating companies. It is good practice to consider all wires "alive," and the employe who does not know the normal voltage of line upon which he is called upon to work, or who fails to determine this voltage for himself, is not likely to be protected in any great degree by yellow crossarms or any other device designed to think for one engaged in so hazardous an occupation.

Paragraph (e) relates to guy wires and guy cables, and provides that all guy wires and guy cables shall be effectively insulated at all times at a distance of not less than 4 feet nor more than 8 feet (measured along the line of said wire or cable) from the upper end thereof, and at a point not less than 8 feet vertically above the ground from the lower end thereof. This is an excellent provision. A further requirement, providing that two or more guy wires or guy cables attached to a pole must be at least one foot apart, in a vertical direction, between points of attachment, is correct, provided such guys are run to a common anchor. There are cases, however, where there are two or more anchors, and in such cases the 1-foot vertical spacing is not good construction; neither is it necessary or desirable to place insulators in guys which are attached to steel poles or towers when same are known to be well grounded.

Paragraph (f) provides that any wires or cables used to conduct electricity and erected or maintained vertically on pole, shall be wholly encased in casing equal in durability and insulating efficiency to a wooden casing not less than 1½ inches thick. The custom heretofore has been to insulate such wires and cables from the point of attachment to line down to a point approximately 6 feet below the lowest crossarm, the object being to protect the lineman from coming in contact with iron pipe with which such cables are frequently enclosed, a thorough ground being established at all times. The chances for accident due to pipe not being protected from a point 6 feet below lowest crossarm or cable are extremely remote. As the intent of the law, however, is to protect life, it is well to concede that this provision is worthy of adoption. Instead of using wood, it is common practice to use fiber conduit, which at once provides a medium for insulation and protection of the conductor contained therein.

Paragraph (g) prohibits the placing of an arc lamp and a transformer on the same pole. This is a correct provision, but should not apply to arc lamps which are not trimmed from pole provided that, in other respects, proper clearance has been established.

Paragraph (h) considers certain phases of the high-tension crossing problem. There are two important provisions in this paragraph: one providing for the high-pole short-span construction at crossings, which is applicable on private rights of way, but limited in its uses elsewhere, and the other consists of a "double-strength construction" scheme. In the rapid development of high-tension work, many companies are providing construction which is as safe as engineering ingenuity may devise. The term "double-strength construction," as applied to such transmission lines, is too general to be effective. There are many communities where high-tension lines are maintained, and these lines cross other circuits and services at frequent intervals. The application of the "double-strength construction" theory implies that it is necessary in such cases to double up on the prevailing factors of safety without any consideration of the hazard involved. This feature alone has forced a number of companies to the use of No. 0000 wire, at which the "double-strength" construction requirement ceases to apply.

Paragraph (i) is as follows:

"Run, place, erect or maintain any suspension wire to which is attached any 'aerial' cable of '75 pair number nineteen, Brown and Sharpe gauge,' or over, or of '100 pair number twenty-two, Brown and Sharpe gauge, or over, suspended from a crossarm (or from any other structure or appliance from which said suspension wire is hung), by a single bolt and clamp without at the same time attaching said suspension wire to said crossarm, structure or appliance by an additional 'safety' bolt and clamp (or other 'safety' appliance for thus attaching said suspension wire) of tensile strength equal to the first herein said bolt and clamp."

A careful examination of the methods adopted to comply with this provision shows that it has introduced extra elements or fixtures, any part of which is not stronger than the single bolt and clamp used heretofore. A careful study of this provision makes it particularly evident that considerable extra work has been provided for without any increase in safety. It has been the practice heretofore to "strain guy" the messenger on curves or corners, which amply provides for the condition implied in this paragraph. Fig. (6)

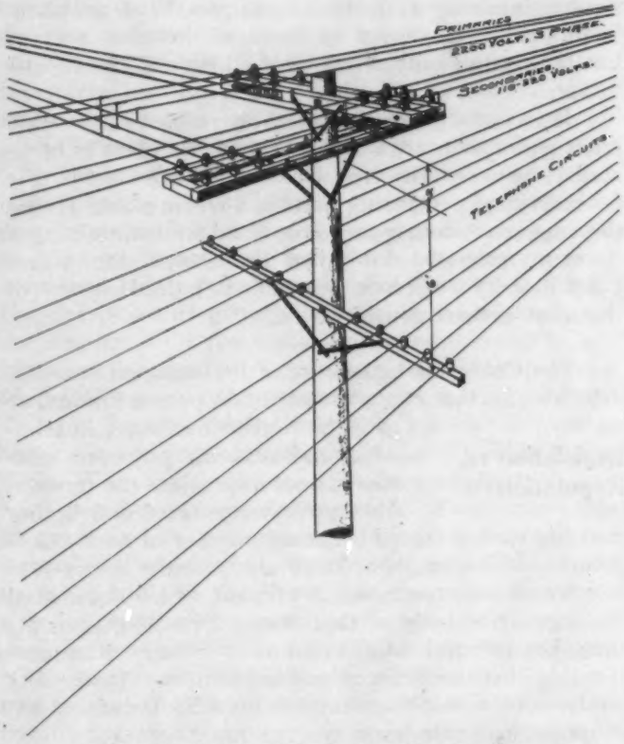


Fig. 6. Proposed Buck Arm Construction

shows one of the best methods of complying with the law, and consists of two three-bolt clamps and strand wire loop around crossarm.

Section (2) exempts from all previous regulations, except the 13-inch clearance from wire to center of pole, all "direct current" electric wires or cables having the same polarity, and "signal" wires, when not more than two such "signal" wires are attached to the same pole. This provides for maintenance of railway feeders and telephone or "signal" wires, but is not clear as to its exact intent. The paragraph reads as if all "direct-current" wires are exempt, but it is not probable that such an interpretation was intended.

Section (3) provides that insulation must be placed in trolley span wire at a distance not less than 2 feet nor more than 4 feet from point at which span wire is attached to the pole, which agrees with good practice. But it further provides that span wires on double-track electric lines must have an insulator in same when these trolleys are more than 10 feet apart. The minimum distance between centers for even narrow-gauge double-track electric lines in Southern California is 11 feet 6 inches. This exception, therefore, provides for a condition which does not exist.

The net result of one year's operation in Los Angeles has been to increase the cost of construction about ten per cent. This increase is made up of a charge for longer poles and the cost of bringing lines up to standard, whenever it is necessary to make any change in overhead.

It has demonstrated fully that all retroactive features of the law should be eliminated. In the natural order of reconstruction and maintenance all obsolete construction is rapidly disappearing, but even considering this, a sum well above one-half million dollars will have to be appropriated by Los Angeles companies to complete the reconstruction in the five-year period allowed for such work. It seems that this is a needless expense and one for which there is no compensation.

It is but natural that we should now consider the possibilities of the immediate future. The Public Utilities Act is recognized as one of the most important results of the present administration. It does not seem probable that the legislature responsible for such a comprehensive measure would be adverse to taking such action as would do away with the confusion now existing as to the overhead law. There is no doubt but that employer and employee would both be glad to see the matter reopened.

In the light of the knowledge gained during the past year, it should be possible to reduce overhead distribution to a real art. Efficient regulation of electrical distribution is a much-desired possibility. The most beneficient legislation may fail in its purpose when not only lawyers, but engineers as well, disagree as to its application.

STATISTICS IN ELECTRICAL INDUSTRY.

Statistics published in a recent British Foreign Office report show that during 1911 the total value of electrical goods exported from Germany amounted to $52,558,000, which shows no increase, and that the imports amounted to $11,436,000, a rise from $7,056,450. The exports of electrical machinery and appliances from the United States during last year were worth, in round figures, about $19,329,000, as against $16,547,300 in 1910. In regard to Great Britain, last year's exports comprised $13,720,000 worth of electrical goods and apparatus, $8,714,500 worth of electrical machinery, and $254,500 worth of electrical porcelain ware, a total of $22,689,000. The imports under these classifications were valued at $6,986,000, $5,114,000, and $191,000, a total of $12,291,000. For 1910 the British totals were: Exports, $28,246,000; imports, $11,217,285.

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The Dovetailing of the Steam Auxiliary

In making studies relative to the determination of the point of economical generation in a central station system having both steam and hydraulic plants, it is evident that as the amount of water storage available plays the most important role, the use of this storage should be given the greatest consideration.

The determination of just what load the steam plants should carry depends on the stream flow available, the peak demand, and the extent of storage to the end that no water is wasted. If this storage can be brought about in the early morning hours while the low daily load is on and the pondage thus obtained is capable of taking care of the peak period, then of course steam power is not required. On the other hand, a recent committee report of the Northwest Electric Light & Power Association states that actual cost data have been obtained from a system that previously used its steam plant to take care of the peaks, but which has for the past two years utilized its hydraulic plants to handle the fluctuations, at the same time maintaining a constant load upon the steam plant. Such operation shows an increase in the average kw.-hr. production per gallon of oil from 2.5 to 4.5 and better.

It is well-known that the best results from steam plant generation are obtained when the plant is operated at or near unity load factor. This also holds true for individual generating units in a steam plant. Hence the suggested saving to be obtained by maintaining a constant, properly dovetailed load upon the steam plant in a hydroelectric net-work is indeed worthy of the most earnest consideration.

Legislation vs. Regulation

The California legislature of 1911 enacted over 800 new laws for that commonwealth. A person unfamiliar with the routine necessary in trimming and revising proposed statutes cannot appreciate the tremendous work necessitated in bringing into life such a record-breaking number of new enactments. Many of these laws are proving themselves worthy of the progressive sentiment which dominated the legislative body of that year. Two of these statutes, No. 499 and 500, have, however, proved unquestionably their inefficiency and unjustness. A complete analysis of these two statutes may be found on another page of this issue.

Under statute No. 499, power companies are put to endless expense, for the enactments are retroactive. If danger to life or property was shown to be avoided, at least some excuse could be given to warrant this wanton waste of money. J. E. Macdonald points out clearly in his analysis that this cannot be accomplished under the present statute.

It is fortunate indeed that the Public Utilities Act, put into effect March 23, 1912, gives full power to the Railroad Commission to bring relief. In its general order No. 26, the commission, acting under its lawful authority, clearly shows that it is dominated by a constructive policy which means much for the future of overhead construction.

It is a source of congratulation, too, that the commission is empowered to act in the matter, for even under the most perfectly drawn law, the march of

invention necessitates constant changes. What is safe and desirable today may be wholly and justly avoided tomorrow. A regulating commission with its corps of experts, keeping abreast of the times, offers an elasticity in proper supervision of overhead construction not to be accomplished by even the most carefully and precisely drawn laws.

Irrigation Facts Important to Electrical Engineers

Scarcely a half dozen years have past since the full realization of the necessity for irrigation throughout practically the entire West. Even those districts which boast abundant mean annual rainfall no longer scoff at the irrigation enthusiast. Countless recent installations emphasize this. As instances, examine the Rogue River Valley and the Willamette Valley of western Oregon, and, indeed, the most productive portions of the Sacramento Valley in California where a few years ago to suggest the possibilities of irrigation was to insult the land owner.

If conclusions such as these are to be drawn from well-watered valleys, what then, is to be said of the remaining vast acreages of the West considered in the past as properly supplied by nature? Only one answer is possible. This answer is silently but impressively making itself felt in the connected daily loads of Western hydroelectric companies. On all sides the irrigation power expert is to be found arguing with the intelligent farmer. Thousands of new electrical pumping installations made during the past year instance the fact that the modern farmer is ready to make any reasonable move to insure continuity of crops and larger return per season from his holdings. Enquire into this growth of connected load and note the findings. Of the three larger companies of California, each at present have a connected pumping load of 25,000 h.p. or over, operating units of from 10 to 20 h.p. Reports from Oregon indicate even greater service in the rural communities. In the other states of the West, conditions are still more emphatic in proportion to the present development. This remarkable progress is but a beginning. Upon estimating the possibilities of utilizing electric power profitably upon irrigable lands of the West, one is almost overcome with its gigantic proportions.

But not alone for the actual pumping load acquired is the rural community valuable. Experience has well proven that the farmer once educated to use the electrically operated pump soon finds countless other applications in his home and about the farm. The farm house, the barn and the bunkhouse soon become electrically lighted. The dairy, too, feels the impetus of modern invention for electrically driven milkers, are fast coming into use. About the farm the electric truck finds its place in the necessary haulage of crops to the market. Finally, that climax of modern comfort and luxury, the limousine, soon is seen taking the farmer and his family upon their outings. The psychological effect, then, of the electrically operated pump sweeps all before it.

Hence, so far as the electrical engineer and the power expert are concerned, this pointing of the index finger in Western progress means but one thing. If they are to be in the running, a comprehensive knowledge of irrigation and its applications are imperative. No longer is the running-broad-jump method of computation to be tolerated. Competition has reduced the issue to a hair-breadth. Often, indeed, an extremely profitable load may be secured if the sales engineer is able to take into account all the favorable features of soil, rainfall, duty of water and other niceties which vary in each community. Knowledge, then, relative to irrigation and its various ramifications is an indispensable asset for the successful Western power engineer.

Knowledge relative to irrigation has but intermittently found its way into the technical press concerned with affairs electrical. Due to the continued and widespread interest of our readers in the ever-growing applications of hydroelectric energy, the Journal, with this issue, takes pleasure in making an important announcement to its readers. Our leading article, contributed by Professor Bernard A. Etcheverry, heralds the beginning of one of the most interesting and profitable series ever undertaken by our editorial force. A continuation of this article in separate and distinct form, yet complete as an entire unit, will appear in succeeding issues. Under a departmental heading, entitled "Electric Pumping and Irrigation," every phase of this subject will be treated, while the matter contained will be largely technical, it is believed that the mathematics employed will not be too severe for a comprehensive grasp of the points discussed.

The great fault usually met with in a series of articles arises from the fact that the busy reader, unable to follow each article as it appears, becomes entangled in a mass of deductions, hinging upon conclusions previously brought out in some article he overlooked. Hence the remaining articles are cast aside as utterly useless reading. In this series each article will be complete in itself. Though general references are at times made to preceding deductions, a reading knowledge is acquired by following the discussion brought out in each separate unit. In a word each article may be understandingly and profitably read without any consideration of its predecessors.

It is seldom our columns have had contributions from one so well qualified to handle his subject. Mr. Etcheverry graduated from the University of California as medallist of his class. As an Associate Professor of Irrigation at the University of Nevada, he gained valuable experience in the surrounding arid community. Some years later, returning to his own university to undertake work in irrigation begun by the eminent irrigation expert, Elwood Meade, he soon built up, as head of the Department of Irrigation, a literature upon Western methods and practice in irrigation not hitherto accomplished. Personal visits of inspection and expert consultation in all parts of California and the Nortwest have made him an authority on Western irrigation practice. It is not surprising, then, that during the current year, in addition to his connection with the federal government as irrigation expert in the department of agriculture, he should be asked by the authorities in the Province of British Columbia to make a comprehensive compilation on practical information relating to irrigation for that province. This report has recently made its appearance in bulletin form under authority of the legislative assembly of British Columbia.

PERSONALS.

Bion J. Arnold is at San Franicsco.

M. H. Sherman, a director of the Pacific Electric Railway, has returned to Los Angeles from a trip around the world.

H. W. Beecher, Northwest manager for Chas. C. Moore & Company, has returned to Seattle from a brief visit to California.

J. P. Bowden, who is president of a Canadian electrical appliance firm, is a recent arrival at San Francisco from Toronto.

F. H. Leggett, manager of the Western Electric Company's Pacific Coast department, has just returned to his headquarters at San Francisco after visiting Los Angeles.

K. Archer, of Paris, who is connected with a Dutch Company manufacturing oil engines of the Diesel type, which are in use on large European steamers, is among the recent arrivals at San Francisco.

Herbert Fleishhacker, one of the directors of the Great Western Power Company, returned to San Francisco during the week from New York City, where he spent some time in connection with financial affairs.

A. W. Bullard, vice-president of the Great Western Power Company made a 400-mile inspection tour of the company's system of power stations, dams and transmission lines before leaving for New York last Monday.

H. W. Clapp and **B. C. Edgar** have resigned their positions with the electrical department of the Southern Pacific Company at San Francisco to join the engineering staff of the Columbus (Ohio) Railway & Light Company.

A. S. Hayward, formerly transformer specialist for the General Electric Company's Pacific Coast District, recently returned to San Francisco after visiting the factory at Schenectady, and will sail on Saturday for Honolulu, where he will open a General Electric agency for the Hawaiian Islands.

Arthur A. Isbell, construction engineer for the Marconi Wireless Telegraph Company, returned to San Francisco last week after superintending some changes in the company's station at Honolulu, preparatory to the proposed operation of the wireless system between the Hawaiian Islands and Seattle.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, plans to leave for the East on November 3. In addition to attending the directors' meeting of the National Electric Light Association he will give a number of addresses on California hydroelectric plants and also urge attendance at the Panama-Pacific Exposition in 1915.

K. G. Dunn, with Hunt, Mirk & Company, has returned to San Francisco after inspecting the work in progress at San Diego, where a large percentage of the underground steam mains for the United Light, Fuel & Power Company, has been installed. The American District Steam Company's system of low pressure steam heating is used. The Spreckels Theater and other large buildings are now being supplied with steam.

S. L. Naphtaly, vice-president of the Oakland, Antioch & Eastern Railway, has returned from the East after conferring with officials of the War Department concerning the bridge the company intends to construct across Suisun bay. All arrangements have been completed and machinery for making the final borings, to determine where the concrete structures will be placed, has been farwarded from the north by the engineers in charge of the bridge construction.

W. H. Leffingwell is in charge of a crew of men who are doing some hydraulic work on the Nevada Valleys Power Company's proposed hydroelectric development on the Truckee River, a short distance east of Sparks, Nevada. According to plans that have been announced, a drop of 90 feet will be obtained by constructing a 4½-mile ditch and a dam 18 feet in height. The latter is to be constructed on the same principle as the Derby dam on the Government irrigation project near Clarks. An installation of two generating units, aggregating 3500 h.p., is contemplated.

S. V. Walton, commercial manager for the Pacific Gas & Electric Company, has returned to San Francisco from an extended trip throughout the East. Mr. Walton has been appointed chairman of the N. E. L. A. Pacific Coast committee on electricity on the farm. The other members are **S. M. Kennedy**, general agent of the Southern California Edison Company; **E. B. Walthall**, assistant general manager of the San Joaquin Light & Power Company; **H. S. Wells**, manager of the new business department of the Pacific Power & Light Company; **C. H. Williams** of the Northern Colorado Power Company; **E. P. Edwards**, assistant manager of the lighting department of the General Electric Company of Schenectady; **H. W. Cope**, manager of the industrial and power department of the Westinghouse Electric & Manufacturing Company. The two latter will represent the large manufacturing companies. The project was brought up at the meeting in Boston recently of the executive committee of the commercial section of the National Electric Light Association, and after the meeting adjourned Mr. Walton and other men of national reputation as sellers of electrical energy, visited Washington and conferred with officials of the Department of Agriculture, who will aid the campaign in many ways. First a booklet will be produced giving the present and prospective users of electricity on the farm concrete facts, showing the value of the power for pumping, lighting, heating, etc. This will be brought out under the auspices of the National Electric Light Association. It is proposed to bring the campaign into the home of every agriculturist.

TRADE NOTES.

J. J. Agutter and associates have organized under the name of J. J. Agutter & Company for the purpose of carrying on a general electrical contracting and engineering business. The firm is located at 73 Madison street, Seattle.

The Westinghouse Electric & Manufacturing Company has delivered the first one of the fifteen electric locomotives ordered by the Pacific Electric Railway Company of Los Angeles. The 60-ton locomotive will be used principally to operate freight and passenger trains on the interurban lines running out of Los Angeles.

The Century Electric Company of St. Louis has inaugurated the practice of assembling its workmen to hear the arguments of noted speakers upon the political questions of the day. The first speaker was Charles W. Fairbanks, former Vice-President, who addressed the employees at noon on October 23rd.

The General Electric Company has sold the Union Iron Works of San Francisco, a quantity of electric equipment for the fine new substation at the Potrero shipbuilding plant. This includes two 6-pole, 3-phase, 200 kw., 1200 r.p.m., 60 cycle, 230-v. rotary converters; one 50 kw., 1200 r.p.m., motor generator set—440 v., 3-phase, a.c., and 125 v. d.c.; one 165 kw., 900 r.p.m., motor generator set—440 v., 3-phase, a.c., and 330 v. d.c.; one 150 h.p., 600 r.p.m. 3-phase, 440 v., induction motor, and an 18 panel black slate switchboard, to control the entire substation, which will furnish current for the operation of the machinery in the yards and shops.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

NEW ELECTRICAL WIRING ORDINANCE AT PORTLAND.

(Concluded.)

Certificate of Roughing in and Final Inspections.

Section 771. The Chief Inspector of Electricity shall be notified in writing by the person or persons doing work, first when roughing in work is completed, and again when the entire work is completed, in both cases within forty-eight (48) hours after the completion of said work. The Chief Inspector or his deputy shall proceed to inspect the same within forty-eight (48) hours, not including Sundays or holidays, after receipt of such notice, and if said work is in all respects in conformity with the provisions of this ordinance he shall attach a notice giving permission to proceed with the installation. Should the inspector condemn any of the said work or equipment as not being in accordance with the provisions of this ordinance, such rejected wires or equipment shall at once be removed and changes demanded by the inspector or his deputy shall be made by the electrical contractor within a reasonable time after written notice is received by him so as to bring the same up to the requirements of this ordinance. In default, said electrical contractor shall be liable to the penalties of this ordinance, and any and every lather, carpenter, mason, electrical contractor, owner, agent or any other person covering or allowing to be covered such portion of work or equipment so condemned, or removing any notice not to cover same placed thereon by the Chief Inspector of Electricity, or his deputy, shall likewise be liable to the penalties of this ordinance. Failure of the Chief Inspector of Electricity, or his deputy, to make inspection as prescribed above within forty-eight (48) hours will be construed to mean permission to the lather, carpenter, mason, electrical contractor, owner, or agent to proceed with the construction of the buildings.

Certificate Not to Be Issued on Incomplete Work.

Section 772. No certificate will be issued on any incomplete work. When any addition or change is made in work upon which a certificate has been issued, a separate permit and certificate shall be obtained for same.

All Pipe Work to Be Installed Before Electrical Inspection.

Section 773. All roughing in plumbing and other pipe or tube work to be concealed shall be in place before electrical wiring is inspected, and no such wiring shall be considered as complete until such piping is in place.

Certificate of Final Inspection to Be Issued Before Connection Made to Source of Power.

Section 774. It shall be unlawful for any electric light or power company to do any wiring of any nature in or on any building, except their own power house or substation, for which a permit has not been issued, or to make any electrical connections to any building until a certificate of inspection of said building has been issued by the Chief Inspector of Electricity; provided, however, that the Chief Inspector of Electricity may issue a temporary permit for the use of electric current during the construction or alteration. No charge is to be made for this temporary permit.

Inspection of Old Work.

Section 775. The Chief Inspector of Electricity, or his deputy, shall have the right to enter into all buildings where electric current carrying wire exists for the purpose of inspecting the same.

Maintenance.

Section 776. The said Chief Inspector of Electricity or his deputy is hereby empowered to inspect or reinspect all wiring in or on buildings and apparatus conducting electric current for light, heat and power, and when said conductors or apparatus are found to be unsafe to life or property he shall notify the person or corporation using or operating them to place the same in a safe and secure condition within forty-eight (48) hours. Any person or corporation failing or refusing to repair, change or remove same within forty-eight (48) hours, or within such further time as the Chief Inspector of Electricity deems necessary, after receipt of such notice, shall be subject to the penalty hereinafter provided.

TITLE II.

All Work to Conform to Electric Code.

Section 777. All electrical wiring and appliances in or on buildings inside of the city limits of the City of Portland hereafter erected, altered or repaired, shall conform to the National Electric Code, Edition 1911.

Section 778. The following local rules shall apply to electrical installation for light, heat and power in or on buildings in the City of Portland and to be an addition to the electrical code as set forth in Section 777.

Conduit Work.

(a) All electrical installations in buildings which are hereafter erected, altered or repaired in the inner fire limits shall have wiring encased in approved metal conduit, provided extensions to existing installations, not installed in conduit may be made in a manner similar to the existing installations, provided the extension does not require any new circuit or circuits.

(b) All electrical installations in basements of buildings which are to be hereafter erected, altered or repaired, in the outer fire limits, unless concealed, shall have the wiring incased in approved rigid or flexible conduit. Installations made in wood or metal moulding not to be construed to be "concealed work." This shall not apply to buildings which are occupied by four families or less.

(c) All buildings hereafter erected, altered or repaired to be used as public garages shall have their electrical wiring encased in either rigid or flexible conduit.

(d) The ends of all wires at outlets, where fixtures are not installed, must be tapped and provided with approved outer covers.

(e) All wiring for signs must be in conduit. For swinging signs conduit to extend to sign axis and terminate in an approved water-tight fitting; from this fitting wires to be neatly cabled, and where the wires enter the sign structure they are to be properly bushed. If sign is of stationary construction, conduit must enter structure in approved manner.

(f) Conduit work on outside of building must be water-tight; socket and receptacles must be weather-proof.

(g) Wiring on outside of building must be encased in conduit.

(h) Conduit must be installed so that it will not be necessary to leave fish wire in same in order to pull in conductors.

(i) All outlet and junction boxes, condulets, unilets, pipe ends and fittings of similar make must always be accessible and must not, under any circumstances, be concealed, and must be secured with screws not smaller than No. 8.

(j) On conduit jobs all necessary cutouts, cutout cabinets, switches and other material and devices must be installed and all outlets properly connected before any certificates of final inspection will be issued.

(k) All conduits must be double lock-nutted to cabinets, outlet boxes, junction, pull and switch boxes.

Knob and Tube.

Section 779. (a) At the three-way and gang switches, taps must be made and secured outside of boxes.

(b) Wires must not run diagonally through joists, studding or timbers.

(c) Wires must be knobbed at top and bottom of partition; that is, just above mud tubes and below the plates.

(d) Broken tubes or knobs must not be used for mud tubes.

(e) All tap wires must be knobbed within six (6) inches of tap.

(f) In attics which are reached only by scuttle hole wires must be kept at least five (5) feet from scuttle, or be considered as subject to mechanical injury.

(g) Do not knob on one-inch header block at outlets.

(h) Avoid running wires under bathrooms or near sinks wherever possible.

(i) Joists to be properly made must be heated sufficiently to allow the solder to flood same, then covered with two (2) thicknesses of rubber tape and at least two (2) thicknesses of friction tape.

(j) Where metal lath or metal ceiling is used outlets must have approved outlet boxes. Open work, knob and tube or cleat work on grounded surfaces, such as metal lath or metal ceiling, is prohibited.

Service.

Section 780. (a) All buildings having their electric service either from overhead or underground service must be fed separately; that is, one building must not be fed through another unless the connection is made by conduit and the conductor carried on outside of building or buried in six (6) inches of concrete or brick. This permission is given only by a written order from the Chief Inspector of Electricity.

(b) In buildings containing more than one (1) tenant all services must be brought to one distributicn center.

(c) No wire smaller than No. 12 B. S. gauge may be used for service.

(d) Service wires for all buildings must be installed in conduit from a point ten (10) inches beyond outside wall to and entering iron cabinet for main service cutout.

(e) All knife switches and cutouts must be installed in approved cabinets.

(f) No fuses, switches or meters must be mounted on back of switchboard. Where such a design is intended, the above apparatus should be mounted on sub-panel at the rear of the switchboard.

Size of Mains.

Section 781. For the purpose of determining the size of wire for mains, each circuit will be considered as carrying full load except theatres, where maximum possible load is considered.

Wooden Moulding.

Section 782. Wooden moulding for electrical wiring is prohibited inside the fire limits, except as set forth in Section 778, (a) and (b). Soft wood moulding for electrical wiring is prohibited within the city limits of Portland.

High Voltage.

Section 783. Wires carrying current in excess of 600 volts are prohibited in buildings except for motors and transformers.

Motor installations above this voltage must conform to the following specifications:

(a) On pole outside of building locate three transformer fuses as starting fuses, isolated from all combustible or inflammable materials.

(b) All wiring must be done with approved multiple conductor metal sheath cable in approved unlined conduit.

(c) All wiring around switchboard must be done with approved rubber insulated wire. This wire must be of approved make for this potential—ordinary 0 to 600 volt wire is not approved.

(d) All open wiring must be supported on porcelain insulators at least 1 inch high, and wires must be 8 inches apart.

(e) Use bushings on the ends of all conduit as a terminal fitting. Do not use outlet boxes or condulets.

(f) No iron cabinets can be used. Use wood—slate or marble lined—that is, build the cabinet of wood.

(g) Wherever lead-covered cable leaves conduit, place a pot head on the lead-covered cable and fill it with asphaltum so as to separate wires. This pot head should be at least twice the diameter of the metal sheathed cable.

(h) Enclose the motor in a dust-proof room when direct current motors are used.

(i) Place the starting panel in the motor room; also the auto starter and the oil switch. If no room is provided one must be built for this apparatus.

(j) Ground thoroughly the motor frame, the conduit and the metal sheathed cable. This grounding to be done with approved clamp.

(k) On the outside of the building the conduit must be turned downward with a bushing on the same and a pot head must be used on the lead-covered cable.

(l) Connect the starting terminals of the compensator between the oil switch or fuses on outside pole and circuit breaker on the starting panel, making the circuit breaker on the panel the "Running Fuses."

(m) If it is necessary to dead end to the building, place several strain insulators in series.

(n) Motor must be so located that it will be readily seen from the auto-starter.

Number of Outlets Per Circuit.

Section 784. The maximum number of outlets per circuit, provided not more than 660 watts are consumed, shall be as follows:

	Outlets.
For stores and offices if more than three (3) ft. apart....	6
In buildings not mentioned above—For concealed work..	12
For open work	12
For signs and outlining the outside of buildings.....	66

is the maximum number, except signs wired in series-multiple; for lamps of five (5) watts or less a maximum of 200 sockets shall be allowed.

Low Voltage Transformer.

Section 785. In low voltage transformer, when the highest voltage of either primary or secondary does not exceed 550 volts and the apparatus that constitutes the load is capable of carrying over one (1) ampere, both the primary and secondary wiring must be installed according to Class "C" rules of the electric code.

When the secondary current does exceed one (1) ampere at twenty-four (24) volts, and is used for signalling work, the secondary wiring may be installed according to Class "E" rules of the electric code.

Extra Hazard.

Section 786. In all installations in stables, barns, breweries, wood-working plants, laundries, packing houses, dye works or factories and where flying dust accumulates, sockets must be waterproof. Unless made upon fixtures, they must be hung by separate stranded rubber-covered wires not smaller than No. 14 B. S. gauge, which should be twisted together when the pendant is over three (3) feet long. These wires must be soldered direct to the circuit wires, but supported independently of them.

Starting Devices.

Section 787. All alternating current motors whose normal capacity is six (6) horsepower or more must be provided with approved compensator or equivalent device to reduce the excessive starting current required; and direct current motors of one (1) horsepower capacity and larger must have starting boxes.

Exit Lights.

Section 788. The exit lights required by Section 713 must be on separate circuit, or circuits connecting on the service

side of the main line fuses, with only one (1) set of fuses between the light and the service main line.

Non-liability of City for Damages.

Section 789. This ordinance shall not be construed to relieve from or lessen the responsibility of any person owning, operating or installing any electrical wires, appliances, apparatus, construction or equipment for damages to anyone injured by any defect therein; nor shall the city, or any agent thereof, be held as assuming any such liability by reason of the inspection authorized herein or the certificate of inspection issued by the Department of Buildings.

Penalty for Violation.

Section 790. Any person, firm, company or corporation that violates, disobeys, omits, neglects or refuses to comply with, or resists, or opposes the execution of, or violates any of the provisions of, or who occupies or maintains any building or structure which was erected or altered in violation of this code, shall be punished by a fine of not exceeding five hundred dollars ($500), or by imprisonment of not more than six (6) months, or by both such fine and imprisonment, and every person, firm, company or corporation shall be deemed guilty of a separate offense for every day such violation, disobedience, neglect or refusal shall continue, and shall be subject to the penalty of this section for each and every separate offense, and so much of any building or structure as may be erected or altered in violation of this Code shall be condemned and torn down at the expense of the person, firm, company, or corporation erecting or altering the same.

CALIFORNIA ELECTRICAL CONTRACTORS' NOTES.

J. G. Sutton Company are installing an 80 h.p in. motors for John Roebling's Sons at Oakland.

The Central Electric Company were awarded an apartment house on Geary and Jones streets, San Francisco, for the sum of $2600.

A great deal of electric work is being done in San Francisco and the surrounding towns at the present. Reports from union headquarters shows that there are no idle men.

C. V. Shneider, manager of the electric Supply Company in Sacramento, was in the city on business during the week.

The wiring for the Kahn Department Store was awarded to the Electric Construction Company of Oakland on a percentage basis. A number of San Francisco firms were called in to submit estimates on this job, and their figures ran close to $20,000. Whether it was the intentions of the owners of this building to let this job on a percentage basis or not, the fact remains that a number of contractors have been put to considerable expense preparing estimates that according to the looks of things the owners did not intend to use.

A committee consisting of C. F. Butte, C. Eppestien, Russ Woldron and W. S. Hanbridge has just completed a revision of the Buyers' Reference Price List of Electrical Supplies for San Francisco District, Local No. 1, California State Association of Electrical Contractors. The new book is much larger than the old one, is gotten up in loose leaf form so as to fit any standard binding, and the committee hopes that it will be the forerunner to a western sheet for the National Data and Sales Book. The prices in the book are what the committee consider reasonable and proper and books are to be sent to all contractors and dealers, but with an understanding that there is no reason that these prices should be used except where in the judgment of the user that they are fair to himself and the consumer. The distribution will take place about December 1, 1912.

The Contractors' and Dealers' Association have appointed the following committee to look after segregation of contracts on the World's Fair buildings: W. S. Hanbridge, representing Electrical Contractors; G. Guthrie of J. G. Sutton Company, representing Plumbers; W. T. Beck, representmening Painters; W. A. Knowles, representing Plasterers; W. A. Burnham, representing Steam Heating men. It is the hope of the Contractors' and Dealers' Association that the Fair Commission will take the same liberal stand on this matter that Mayor Rolph and the City Architectural Commission took, and segregate the work on each building into several contracts, therefore not making it necessary for the contractors, who really do the work and must necessarily finance this work, "with the assistance of their supply men," to bury their identity, have their bids peddled, and assume the risk of not getting their money which will be the case many times if the Commissioners insist on giving the work to a general contractor.

OREGON RULING ON "OLD CODE" WIRE.

The Underwriters' Equitable Rating Bureau of Portland has notified electrical contractors, wire manufacturers, jobbers and the electrical trade in general, who might purchase "Old Code" rubber-covered wire, that only stocks in Oregon on the 1st of August, 1912, are acceptable. No wire of the "Old Code" type shipped direct from a factory or other stocks outside the State is acceptable. All "Oregon Stocks" are invoiced in this office and all purchasers of "Old Code" wire should find out whether or not the wire they contemplate purchasing is from an "Oregon Stock." Therefore, whenever wire of the "Old Code" type is found being used which does not come from "Oregon Stock," it will not be passed and if not removed after a reasonable time the fire insurance rate will be readjusted.

SAN FRANCISCO JOVIANS.

At the luncheon of the San Francisco Jovians on October 28th, J. A. Vandegrift gave an interesting talk on the process of manufacturing tungsten lamps. On November 5 A. V. Thompson will talk about the annual Jovian convention at Pittsburgh and provide other entertainment. The meetings are held at Tait's Cafe at 12:15 on Tuesday.

SPOKANE JOVIANS.

The Jovian luncheon on October 22d at Davenport's, Spokane, was addressed by T. H. Koerner, general agent of the Alaska-Pacific Steamship Company, on "Benefits this Territory Will Receive from the Panama Canal." E. Ashton, of the Inland Portland Cement Company, gave an address, illustrated by lantern slides, on "The Manufacture of Portland Cement." On October 24 the Jovians in a body visited the Little Falls and Long Lake development of The Washington Water Power Company, and the Nine-Mile plant of the Inland Empire Railroad Company. The party left in automobiles early in the morning and returned at night, being entertained for a camp dinner as guests of The Washington Water Power Company at their Long Lake plant.

TRADE NOTE.

The Electric Boat Company, of Groton, Connecticut, has decided to establish headquarters at Port Townsend for the finishing and testing of submarine boats. The company makes a specialty of this class of work and has come to the conclusion Port Townsend is a good location for it. Machinery has been ordered and contract entered into with the Key City Light & Power Company for a considerable amount of current to be delivered at the company's plant when in operation.

NEW CATALOGUES.

The Standard Underground Cable Company have issued a neat unique illustrated description of their extensive line of cable terminals and junction boxes in the form of a representation of a trunk.

INDUSTRIAL

LARGEST DIRECT CURRENT GENERATORS.

Seven vertical water wheel type electric generators, which represent units of the largest capacity ever built for generating direct current, will be installed in the new plant of the Southern Aluminum Company at Whitney, N. C. Each machine will have a rating of 5000 kw., delivering 20,000 amperes at 250 volts and operating at a speed of 170 r.p.m. Two smaller direct current generators of the same type, rated 2500 kw. at 300 r.p.m.; two 1250 k.v.a. alternators, having a speed of 514 r.p.m., with two 16 kw. exciters, and all necessary switchboards and controlling devices are also included in the installation.

The contract for all the electrical apparatus has been placed with the General Electric Company, and the installation will be one of the largest and most modern of its kind in the world. It is the intention of the Southern Aluminum Company to push to completion the project now under way and to have in operation in the course of the next eight months a manufacturing plant that will turn out some 25,000 tons of aluminum annually.

The company was recently incorporated under the laws of the State of New York with a capitalization of $8,000,000 and was organized by some of the largest aluminum manufacturing companies of Europe. The enterprise has been financed in France and is closely associated with L'Aluminum Francais of Paris. The work at Whitney is in charge of Dr. Paul Heroult, an eminent French engineer, who is recognized as one of the most expert authorities in the world on the manufacture of aluminum. Although Dr. Heroult has been directing constructive operations there but a few weeks, remarkable progress has been made, and it is confidently expected that the entire plant will be in readiness for turning out the product of the company by the middle of 1914.

The plant throughout will rank among the greatest and most perfectly equipped for the manufacture of aluminum in the United States. Only one other in the country, at Niagara Falls, can compare with it. In the complement of buildings are nine furnace rooms, wherein the alumina will undergo the various processes incidental to conversion into aluminum. Each of these structures measures 60 by 500 ft., and one electrode factory of similar dimensions is also included in the group.

Aluminum, because of its lightness and toughness, finds an almost universal application nowadays. Wire and cable made of this product are rapidly coming into extensive use for the transmission of high tension electric power. A certain type of clay termed bauxite, which is found in Georgia and the middle West, enters into the manufacture of the commodity. From bauxite alumina is made, and through delicate and intricate electrolytic methods this is then transformed into aluminum.

The immense machines, which will supply the electric current for the several operations of this vast industry, will be installed immediately over wheel pits and direct connected to vertical shafts of S. Morgan Smith turbines by forged steel flanged couplings. Each 5000 kw. generator will weigh in the neighborhood of 150 tons, measure 22 ft. in diameter and extend 13 ft. above the floor level. The entire rotating element of the generators will be supported from an overhead thrust bearing. While the normal speed will be 170 r.p.m., they will be designed with provision for a safety runaway speed of 75 per cent above normal. Simplicity will characterize the switchboards and controlling devices, and they will consist of types entailing an effective minimum number of parts. The wheel governors will be provided with remote electric control for both hand and automatic operation.

A NEW ELEVATOR MOTOR.

A new line of direct current, commutating-pole elevator motors has recently been put on the market by the Westinghouse Electric & Manufacturing Company. The principal reason for the development of this new line was the demand for a quiet operating direct current motor requiring a minimum of attention. In order to obtain the latter characteristics, type SK elevator motors have commutating poles, extra large and cool running bearings, and a very rugged and substantial construction throughout.

Excellent commutation is obtained principally by the use of commutating poles. This feature results in sparkless commutation even under severe overloads; frequent starting and stopping, and rapid acceleration incident to elevator service. Good commutation results in long life of commutator, brushholders and brushes; while freedom from deposits of copper and carbon dust keeps the insulation of the windings and the commutator in good condition.

The motors develop very high torque at starting, and the controller is arranged to cut out the starting resistance automatically at a rate which keeps the torque practically constant while accelerating. The elevator car is, therefore, quickly started and rapidly accelerated to full speed.

A New Elevator Motor.

Another advantageous point claimed for these motors is their quiet operation, a feature obtained by the peculiar design and distribution of its windings, and certain mechanical adjustments.

Quiet operation makes these motors very desirable for elevator installations in hotels, apartment houses, hospitals and office buildings, where a noisy operating motor would be objectionable.

The frame yoke is a slab of open-hearth steel, hot-rolled into its circular shape. It is riveted under pressure to a one-piece pressed steel foot, the bottom of which is machined to dimensions for mounting. The armature has a laminated core with ventilating slots. The shaft is removable without disturbing the armature windings or commutator connections. The commutator end of the shaft has an extension of 1¼ in. clear of the housing. This feature makes it possible to turn the armature on its shaft by means of a wrench.

For different kinds of elevator service, these motors are made in three classes. Class I comprises adjustable speed motors, suitable for high-speed passenger elevator service; Class II, for moderate-speed freight and passenger elevator service; Class III motors for slow-speed freight elevators.

NEWS NOTES

INCORPORATIONS.

SALEM, ORE.—Designating its capital at $2,500,000, and its incorporators as Max Smith, Marion F. Dolph, and Willis McGuire, the Ewbank Electric Transmission Company of Portland, has filed articles of incorporation. The purpose of the company is to obtain patents for a system of gas and electric transmission of power, and it is authorized to build and operate street car systems and to manufacture all kinds of motor vehicles.

SALEM, ORE.—Articles of incorporation for the Bandon & Oregon Eastern Railroad Company have been filed here, the incorporators being Roscoe C. Nelson, H. D. Simon and J. V. Beach. Capital stock is $100,000 and Bandon named as the principal place of business. The company is organized to construct a railroad from Bandon in Coos county, through the counties of Coos, Curry and Josephine to Eagle Point in Jackson County and also branch lines from Bandon to Marshfield and from Bandon to Port Orford.

ILLUMINATION.

MOCCASIN, MONT.—The Great Falls Power Company will erect a station here.

ABERDEEN, WASH.—K street, this city, is to be lighted with cluster lights. The property owners will furnish the posts and the cost for 16 clusters is estimated at $35 per month.

HEMET, CAL.—The Southern Sierras Power Company is preparing to extend its lighting service to Park Hill residents, as soon as a sufficient number have signed for lights to justify action.

LYMAN, WASH.—An ordinance has been passed by the city council granting permission to the Pacific Northwest Traction Company to erect, maintain and operate an electric lighting system in this city.

GALLUP, N. M.—Application has been made to the city council for granting of a franchise for the erection of a new electric lighting and power plant for the city. T. A. Fabro and J. M. Mase are promoting the business, Mr. Mase acting as manager.

POTLATCH, WASH.—The West Coast Power Company, J. E. Wickstrum, engineer, Seattle, is planning on installing a 300 h.p. hydroelectric plant on the Skykomish River near here. The plant will be built for commercial purposes and, it is claimed, contracts for half the power developed have been made.

SEATTLE, WASH.—The city utilities commission has recommended for passage an ordinance providing for submitting the question of a bond issue of $425,000 to the voters at the general election next March, the fund to be used for installing a steam auxiliary plant at the south end of Lake Union to aid the lighting department.

FRESNO, CAL.—The city government has received notification that the Pacific Gas & Electric will bring suit to prevent the enforcement of the dollar-gas ordinance which was passed last spring on an understanding that the company would not resist it this fall. The ordinance took effect October 1, reducing the rate from $1.35 to $1.

LOS ANGELES, CAL.—A temporary check to advertising $25,000 bonds voted by the citizens of Newport Beach for the municipal electric lighting plant, has been given by the opposition of the Newport Electric Light & Power Company, which has raised the question whether provisions governing public utilities apply to the municipality conducting such business under the law.

SAN DIEGO, CAL.—Notice is hereby given to all stockholders of the San Diego Consolidated Gas & Electric Company that a meeting will be held December 23 for the purpose of considering and acting on the proposition of increasing the bonded indebtedness of the company not exceeding $3,000,000; said bonds to be issued for the purpose of discharging floating indebtedness of the corporation. Bonds payable not later than December, 1922, bearing interest at a rate not to exceed 6 per cent per annum.

FRESNO, CAL.—To supply Fresno with natural gas from the Coalinga oil fields it would cost the city anywhere from $250,000 to $425,000, according to estimates made by City Engineer Jensen and Civil Engineer Tillman. These estimates are based on the laying of an 8-inch pipe line over a distance of 68 miles. Jensen figures the maximum cost at $425,000 and the minimum at $250,000. Tillman places it at $390,000 for 8-inch pipe or at the rate of $1 per lineal foot. For 6-inch pipe the cost would be less than a quarter of a million, but it is believed this size would be too small to supply the demand in the pipe line now in operation between the Sunset fields of Kern County and Los Angeles 8-inch pipe is used. Another line of 8-inch tubing is now being laid and the supply is said to be unlimited.

TRANSMISSION.

ESCONDIDO, CAL.—The Escondido Light & Power Company, a new electric and power company organized some time ago, to furnish light and power to country districts, is arranging to start work on a system to cost about $40,000. The stock of said company is offered for subscription.

CONCRETE, WASH.—The city council has been asked to grant the Stone & Webster interests a fifty year franchise for the use of a sufficient number of streets and alleys to enable the company to build, maintain, and operate a continuous system of high extension wires from the east to the west limits of the city.

THE DALLES, ORE.—The Pacific Power & Light Company has started work on a new transmission line to cross the Columbia River and supply power to the Grandalles Orchard Tracts Company's pumps. The line calls for 342 poles and steel towers. The longest span will be 2700 ft., 150 ft. towers being employed. Two new transformers will be installed at The Dalles substation.

DOWNIEVILLE, CAL.—The Marysville & Nevada Power Company, promoted by Jas. O'Brien of Marysville, is advertising for bids for running a tunnel to divert the waters of the river at Goodyear Bar for the purpose of generating electricity. The water is to be taken through a point and dropped to the power house. A dam will be built next year to raise the water to the level of the tunnel. Jason K. Meen and John E. Ebert, both of Marysville, are associated with O'Brien in the enterprises, as is also James K. O'Brien.

TRANSPORTATION.

HOOD RIVER, ORE.—It is reported that the Harriman interests will construct an electric line in the Hood River valley.

POCATELLO, IDAHO.—A syndicate headed by James H. Brady, local capitalist and others, has asked the city for a street railway franchise.

CENTRALIA, WASH.—The Olympia Terminal Railway Company has been organized to operate an electric line between Olympia and Chehalis.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will start at once the construction of a double street railway track 1¾ miles into the peninsula.

MONROE, WASH.—The Kirkland-Redmond Railway, Light & Power Company has asked for a franchise to lay rails on Ferry and Fremont streets and agrees to have cars running by October 10, 1914.

RIALTO, CAL.—The Board of Trustees has adopted an ordinance granting a franchise to the Crescent City Railway Company to construct a single or double track street and interurban railroad for a period of fifty years.

LONG BEACH, CAL.—An appropriation of $170,000 has been made by the Pacific Electric for improvement of tracks at Long Beach. The intentions are to replace the light weight rails in the business center with heavy steel, heavily ballasted, laid on 12 inches of crushed stone, surface paved.

SAN BERNARDINO, CAL.—The people of Redlands and Highlands are coming to the aid of San Bernardino in raising the $35,000 fund to purchase the right of way for the Pacific Electric Railway Company into this city. About $10,000 remains to be raised of a total of $42,000, representing the cost of both shop site and right of way.

PETALUMA, CAL.—Contractors have begun grading in Liberty station for the new electric railroad which is to be built from that point to Two Rock Valley and later to Bloomfield. The Petaluma & Santa Rosa Valley Railway Company intends to go ahead with the work of building the road, which it contemplates having finished before the first of next year.

LOS ANGELES, CAL.—Declaring that the California Main Line Railroad, which was incorporated February 14, 1912, under the name of the California Air Line Railroad Company, with a capitalization of $20,000,000, is ready and willing to finance the construction of the municipal railway to the harbor for the city, Attorney Glen Behymer of the firm of Behymer & Craig, has filed an offer with the city council to construct and operate the road.

RIVERSIDE, CAL.—The Chamber of Commerce is considering the proposals of the American Traction Company to locate in this city. The traction company wants a formation of local capitalists for a company, to whom it will give the right to manufacture machines upon which it holds a patent, retaining exclusive sale of same at designated profit to manufacturers. Henry F. Boynton, L. P. Nemcomb and J. P. Barker, representing the company, are in the city.

SAN FRANCISCO, CAL.—Delays in the construction of the cars for the Geary street road by W. L. Holman & Company have become so serious that Mayor Rolph has been asked by the Board of Works to summon the contractors and their bondsmen for an investigation. City Engineer O'Shaughnessy reported to the Works Board that it would take the contractors several months longer to complete the cars than the contract specified, and that the last 11 cars probably would not be finished until after September 11, 1913.

EXETER, CAL.—The presence here last week of Paul Shoup and C. H. Jasper, traveling freight agent of the Southern Pacific who, together with W. P. Ballard, local superintendent of the Visalia Electric, went over the line and then to Lindsay and Porterville was for the purpose of ascertaining the feasibility and cost of electrifying the Southern Pacific line from Goshen to Visalia and from Exeter to Porterville and to run electric cars between these points, both ways from Exeter. After going over the projected lines they went away leaving it for the superintendent here to make an estimate of the expense necessary. This was later done and the matter has gone up to the head office for consideration.

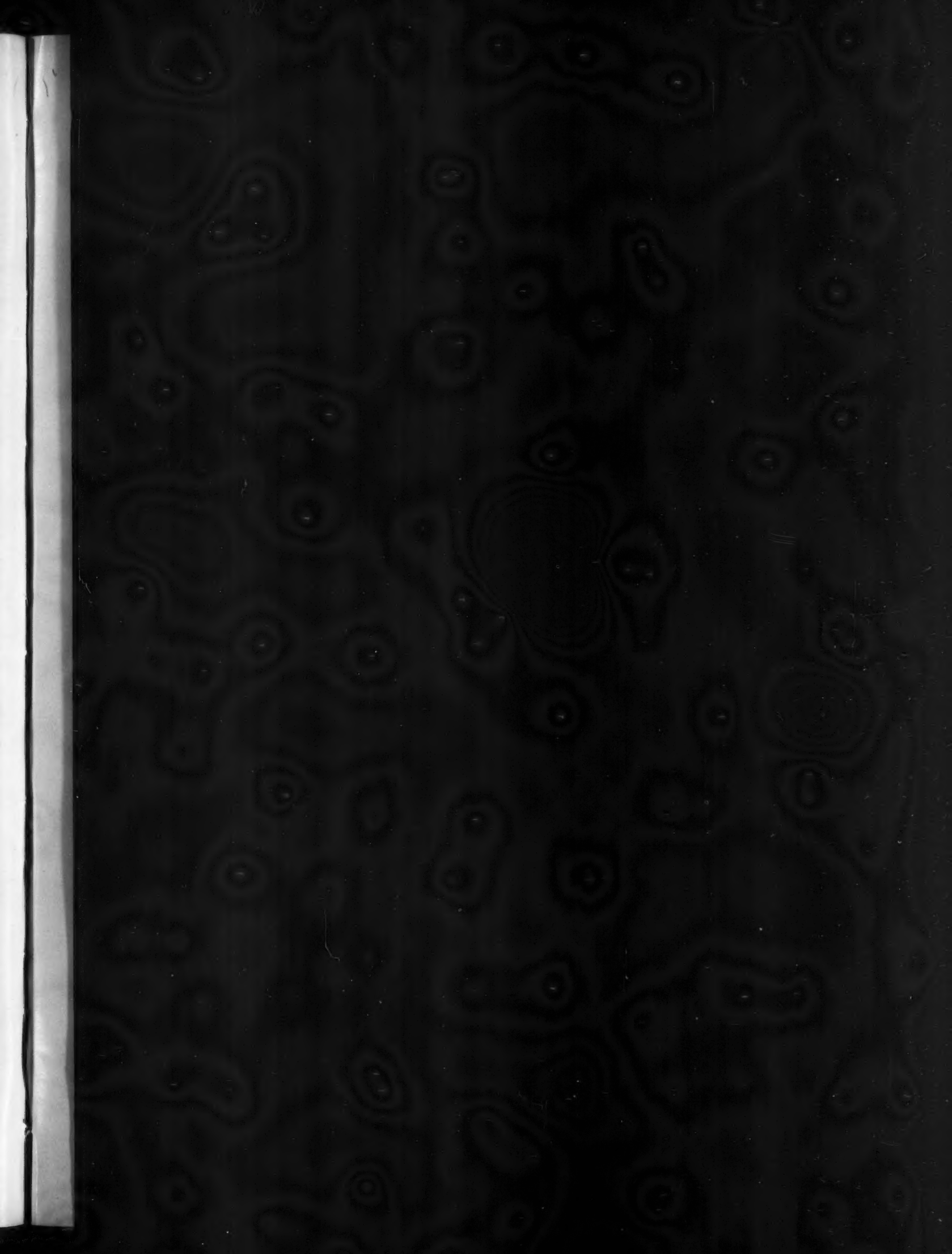
LOS ANGELES, CAL.—With the adoption of a compromise plan for the relief of traffic congestion on Main street, the councilmen are now united in an effort to expedite the plans and to proceed with the actual construction of the street railway line on San Pedro street. The Board of Public works has instructed the city engineer to prepare the plans and specifications and the estimated cost of the link of the municipal railway from Ninth to Aliso streets. The compromise plan as adopted by the Council provides for the following: The construction of the link of the municipal railway on San Pedro street between Ninth and Aliso by the city; the road to be actually built by the Pacific Electric for the city, on payment of a small installment, and the balance on easy terms; the granting of an indeterminate operating franchise to the Pacific Electric revocable by the city with one year's notice, the maximum tenure being seven years; the right to be given to the Pacific Electric to use Los Angeles street, between First and Seventh streets, if the city terminates the right to use San Pedro street during the seven-year term; the Pacific Electric to use Los Angeles street, for a period of ten years from the date of the grant, to be terminable at the expiration of the 10-year period with one year's previous notice; the city to reserve the right to construct the line on Los Angeles street for use by the Pacific Electric, this option to be declared by the city when the San Pedro street franchise is terminated; the maximum term in any case to be 21 years, in accordance with the provision of the charter.

TELEPHONE AND TELEGRAPH.

SOUTH PASADENA, CAL.—The Merged Sunset and Home Telephone Companies of Pasadena, have purchased a site on Mission street and will erect a substation on the property.

REDLANDS, CAL.—The city trustees will order the removal of all electric light, telephone, telegraph and traction line poles on the main streets in the business section of the city. The companies will be forced to place their wires underground.

TROPICO, CAL.—The Pacific Telephone & Telegraph Company has been granted the right to construct and for a period of 21 years maintain and operate a telephone and telegraph system for all purposes, commercial or otherwise, in all highways and public places in the city of Tropico.

BERKELEY, CAL.—Acting for the city council, City Attorney R. C. Staats, has filed a suit in the Superior Court in Oakland to prevent the merger of the Pacific Telephone Company with that of the Home Company. The action is to be taken at this time to intercept the Pacific Company in its work of dismantling the Home Company plant. If the City Attorney is not successful in this action, further proceedings will be instituted to attempt to secure for the city the forfeiture of the $25,000 bonds deposited with the city when the Home Company secured its franchise.

NEVADA CITY, CAL.—The telephone line between Miller's ranch and Camptonville which was constructed by the Tahoe National Forest service within the forest, has been completed and the line between Schaefer's Mill camp and the Truckee Rangers' station is also ready for service. This line will connect the forest service's Lake Tahoe system with the Truckee range station near Truckee. The Tahoe forest is now crossed with a network of telephone lines, which during the past two fire seasons has aided materially in the prevention of large forest fires.